



# ENCYCLOPÆDIA BRITANNICA

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CAST-IRON to COLE

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for the materials of his tragedy. The two parts of this play, like all those by Castro, have the genuine ring of the old romances; and, from their intense nationality, no less than for their primitive poetry and flowing versification, were among the most popular pieces of their day.

Castro's *Fuerza de la costumbre* is the source of *Love's Care*, a play ascribed to Fletcher. He is also the reputed author of *El Prodigio de los Montes*, from which Calderón derived *El Mágico-prodigioso*.

His *Obras* were edited by E. J. Martínez (Madrid, 1925).

**CASTRUCCIO CASTRACANI DEGLI ANTELMINELLI** (1281-1328), duke of Lucca, born March 29, 1281, at Castruccio, near Lucca, was a noted *condottiere* and Ghibelline. He was exiled at an early age with his parents and others of their faction by the Guelphs, who were then in power. He served under Philip IV of France in Flanders, then with the Visconti in Lombardy, and in 1313 under the Ghibelline chief, Uguccione della Faggiuola, lord of Pisa, in central Italy. He assisted Uguccione in many enterprises, including the capture of Lucca (1314) and the victory over the Florentines at Montecatini (1315). An insurrection of the Lucchese led to the expulsion of Uguccione and his party, and Castruccio regained his freedom and position, and the Ghibelline triumph was assured. In 1316 he was elected lord of Lucca, and spent many years in incessant warfare against the Florentines.

He was at first the faithful adviser and staunch supporter of Frederick of Austria, who made him imperial vicar of Lucca in 1320. After the battle of Mühldorf he switched his allegiance to the emperor Louis the Bavarian, whom he served for several years. He defeated the Florentines at Altopascio in 1325, the year in which he was created duke of Lucca, Pistoja, Volterra and Luni by the emperor Louis the Bavarian. In 1327 he captured Pisa, of which he was made imperial vicar. But, subsequently, his relations with Louis seem to have grown less friendly and he was afterward excommunicated by the papal legate in the interests of the Guelphs. He died Sept. 3, 1328.

**BIBLIOGRAPHY.**—Niccolò Machiavelli's *Life of Castruccio* is a mere romance; it was translated into French, with notes, by Dreux de Radier in 1753. See F. Winkler, *Castruccio, Herzog von Lucca* (Berlin, 1897); Gino Capponi, *Storia di Firenze* and G. Storza, *Castruccio Castracani degli Antelminelli in Lunigiana* (Modena, 1891); and S. de Sismondi *Histoire des républiques italiennes* (Brussels, 1838).

**CASTRUM MINERVAE**, an ancient town of the Sallentini in Calabria, 10 mi. south of Hydruntum (mod. Otranto), with an ancient temple of Minerva, said to have been founded by Idomeneus, who formed the tribe of the Sallentini from a mixture of Cretans, Illyrians and Italian Locrians. It is also said to have been the place where Aeneas first landed in Italy, the port of which he named *Portus Veneris*.

**CAST STEEL:** see CRUCIBLE CAST STEEL.

**CASUAL LABOUR** is a term used to denote discontinuous or irregular employment or, as a collective, the workers subject to such employment.

#### GREAT BRITAIN

**Building.**—The term casual labour is sometimes used to describe the employment conditions in such trades as building, which are frequently subject to large seasonal fluctuations. These fluctuations may be due directly to the climate: statistical inquiry has shown in various European countries a distinct correlation between the seasonal decline in employment in the industry during the winter months and the prevailing temperature during these months. Technological advances, however, considerably extended the possibilities of building construction in cold weather; and while in some respects the cost of winter building exceeds that of summer work, this may be offset by the benefits of eliminating seasonal fluctuations. Nevertheless, in the United Kingdom before 1939 there was a widespread reluctance on the part of prospective occupants to take a new house built at any other time than between April and September. Naturally this attitude disappeared in consequence of the housing shortage following World War II. Elsewhere rising rates affect the period over which building tends to be spread. The matter is further discussed in the International

Labour office report on *Seasonal Unemployment in the Construction Industry* (1951).

**Port Labour.**—The term casual worker is, however, more usually applied to the man whose employment normally, and not only periodically, consists of a succession of jobs of short duration, whose contract of engagement is by the day and even by the hour, and who, from the method by which he is engaged, may be uncertain in the morning whether work will be available in the afternoon. He was typified, particularly during the latter part of the 19th and the earlier part of the 20th centuries, by the casual labourer at the docks. It was in the dock industry and the ancillary transport trades that casualization was most extensive; it was here that the phenomenon was investigated at greatest length, and here that the biggest efforts toward decasualization were made.

The conditions governing labour in the London docks during the early years of the 20th century were succinctly described by William Henry Beveridge (afterward Lord Beveridge) in *Unemployment* (London, 1908). They may be taken as broadly applicable to the other large dock areas of Great Britain. The fundamental condition leading to the existence of casual labour in the docks was that the demand for labour was distributed among a multitude of different employers with little fluidity or co-operation between them. Two important features were the great irregularity of the arrival and departure of cargoes and the small extent to which machinery had at that time and even later been able to displace manual work. As a consequence of the irregularity of cargoes there were considerable daily or weekly variations in the amount of work to be done at any one centre of waterside employment. As a consequence of the dependence on manual labour the effects of this varying demand tended to be thrown mainly upon the labourers, whom, beyond certain limits, it was uneconomic to employ regularly, and who were taken on and put off at short notice as they were wanted or were not needed. Every distinct centre of waterside employment required for its smooth working to have immediately available a larger number of men than it could employ regularly or even adequately. From this it followed that each separate employer, in order to be able to call upon sufficient labour to satisfy his peak demand, tended to keep available a separate pool of potential labour; the aggregate of all these separate pools was much larger than would have been the case had there been complete co-operation and complete fluidity between the various centres of employment.

Each employer engaged his men as and where he could get them. What generally happened was that a number of men would assemble in a stated place at a stated time, and the employer's foreman would select workers from them, thus collecting a labour force sufficient to meet his firm's requirements for the next few hours. The formation of these separate pools of labour probably came about largely unconsciously. Men tended to return to a centre where they had previously been successful in getting work, and where they hoped they might be known, rather than to chance the hazards of going further afield. At the same time, however, some more or less deliberate measures appear to have been adopted by employers to keep the reserve together: thus work which might have been done always by the same men was sometimes given out in rotation so as to have enough men always in close attendance for emergencies. For example, a special committee on unskilled labour set up by the Charity Organization Society (1908) reported that it was found at certain London wharves that the permanent staff averaged only 70% of the minimum numbers employed on the slackest days. The remaining 30% of constant work, together with the casual work, was distributed over a large reserve of irregular hands.

From the worker's point of view, the element of chance in securing employment was evidently the salient feature. The man seeking work in the first place had to forecast the probable demand for labour at the different centres within the docks without any adequate information. At any centre he chose he had to compete with a "struggling crowd," the great majority of whom were unknown to the employer or his agent who undertook the selection of workers. The effects of this irregular and unpredictable employment upon the individual were commented on by a number of



sociologists at the end of the 19th and the early part of the 20th centuries. Speaking of casual labourers at the London docks in the 1880s, Beveridge says: "The knowledge that any man, whatever his experience, however bad his antecedents, might get a job at the Docks, attracted to their neighbourhood a perpetual stream of blackguards, weaklings and failures from every other occupation. The experience, soon made, that regular attendance was not necessary to secure selection on days when work happened to be plentiful and the daily alternations of hard exercise and idleness rapidly developed in those who came, if they had it not before, the greatest irregularity of habits and physical or moral incapacity for continuous exertion. The low physique and half-starved condition of many of the labourers made their work dear at 4d. an hour. The London dock casual was popularly regarded as 'the scum of the earth'; the system of dock employment was aptly described as, in effect, 'a gigantic system of outdoor relief.' All could get occasional shillings, few a decent living." (*Op. cit.*, 1930 ed. pp. 87-88, Longmans Green & Co. Limited.)

**Decasualization Schemes.**—Many attempts were made to introduce some measure of organization into this chaos. As a result partly of the strike of 1889, partly of the investigations of Charles Booth, the London and India Docks company initiated measures of decasualization during the 1890s and after, which included, first, the formation of registers or lists of workers to whom preference was normally given, and, second, the making of the whole of the company's dock area into a single labour market instead of a number of separate and distinct areas of employment. In the single labour market the required supplies of men were directed from a central office to the different work places. This scheme was extended when the Port of London authority was established in 1909.

During the first 30 years or so of the 20th century a number of other schemes were set up in various British ports. Thus in 1912 the port employers of Liverpool, the port-workers' trade union, the board of trade and the treasury co-operated to bring into existence the Liverpool dock scheme. Another scheme was set up in Bristol in 1916. The ministry of labour's Port Labour Inquiry committee, appointed in 1930, found 31 schemes which were at that time in operation in various ports. The report stated that by this date all major ports were involved with the exception of Glasgow and the Tyne and Wear ports, and that more than two-thirds of port transport workers were covered. The chief features of these schemes to promote decasualization were that: (1) they were all registration schemes—that is, that they involved the maintenance of a register of men who received preference in the selection of labour; (2) they were voluntary schemes, operating without any legal sanction, though generally with the assistance of the ministry of labour, which often provided secretarial or clerical help; (3) the majority of them were operated jointly by representatives of employers and of workers; (4) generally each scheme provided for the centralized engagement of labour, though it was stated that in some ports this was found to be impracticable; (5) no provision was made for guaranteed minimum income. The committee considered the question of labour wastage and recruitment—obviously an important feature of decasualization schemes—but reached no very definite conclusions. They found that the registration schemes had worked well and had brought into dock work a much better type of employee than was typical at the end of the 19th century; and they felt that registration was an essential preliminary to any decasualization scheme.

During World War II it became imperative to introduce a greater measure of organization into dock work, partly because of the general labour shortage, partly because of the effects of bombing and the need for greater flexibility of the labour force. Consequently, statutory port registration committees were set up early in the war; and under the Dock Labour (Essential Work) order, 1941, a National Dock Labour corporation, with local boards, was appointed. The order also empowered the minister to make dock labour schemes, the essential points of which were that all port workers were to be registered; that all workers, when not actually in employment, automatically entered a reserve pool and were deemed to be in the employment of the corporation; and that,

when in the reserve pool, they had to report to a control point as required, and, if not allocated to jobs, received attendance money. Thus a system of guaranteed pay was a feature of these schemes.

Another phase in the process of dock labour decasualization began when, in 1946, the Dock Workers (Regulation of Employment) act was passed. This, with orders and a scheme made by the minister of labour under it in 1947, regulated the system of decasualization in Great Britain.

Provision was made for the setting up of a National Dock Labour board, which succeeded the corporation in June 1947 and became responsible for the administration of the scheme. In addition, local dock labour boards were to be set up in each port or group of ports; by the beginning of 1952 there were 25 such boards. The national board consists of a chairman and vice-chairman and not less than eight or more than ten other members, four of these other members representing dock employers and four dock workers. All the members of the board are appointed by the minister of labour after consultation with the National Joint Council for the Port Transport Industry. Local boards also consist of representatives of dock workers and of employers in equal numbers.

The chief functions of the national board are to maintain a labour force of a size suitable to current conditions, to maintain a register of employers and a register of workers and to provide for the training and welfare of dock workers. All these functions, except the first, are also functions of the local boards, and much of the work of the national board is in fact carried on through these local agencies.

Broadly speaking, only those persons whose names are on the board's register are eligible for employment in dock work. Every person whose name is on the register is required to attend at a call stand in his port at stated times, generally twice a day, for work. If none is available for him at any one of these "turns," he is entitled to "attendance money" at the rate of five shillings per turn. If he has attended a full week without obtaining work, his entitlement is increased so as to bring it up to a guaranteed week's wage, varying according to the age and medical category of the worker. The pay of those workers who have earned less in a week than the amount of the guaranteed wage is also made up to the minimum. If the worker does not report at the call stand and furnishes no adequate excuse he forfeits his claim to any payment for the week in question. Where conditions lead to a sudden temporary shortage of labour, the local board is empowered to open a temporary register until the abnormal shortage disappears. This provision, which would seem on the face of it to be contrary to the principle of decasualization, does not appear to have given rise to any great difficulties. The national board is also empowered to transfer labour from one port to another in order to equate supply and demand.

Attention was also given to the development of welfare services, including the provision of medical centres and canteens, the appointment of welfare officers, the promotion of educational activities and the supervision of benevolent funds.

The income of the national board is derived from a levy on the wage bills of the employers. This levy is equivalent to a percentage of the wage bill, the rate being fixed by the board from time to time. Out of this income the board pays attendance money and the amount necessary to make up each worker's pay to the guaranteed minimum. From it also come holiday pay, the employers' national insurance contributions and the expenses of maintaining welfare services.

The board is thus not in receipt of any public money. Moreover, although it was set up under the provisions of an act of parliament, it is not a department of government. Nor is it an employer. It may perhaps be described as the agent of the port employers, but it occupies a somewhat anomalous position which can give rise to difficult questions of practical politics.

**Other European Countries and the Commonwealth.**—In many other countries with large maritime interests decasualization schemes have been initiated. Such countries include Canada, Australia, New Zealand, India, France, the Netherlands, Bel-

gium, Norway and Sweden. These schemes vary considerably in detail. It may be said, however, that they all include some method of limiting the number of dockers competing for work by granting to certain of them a priority right in the port concerned. In some of the countries mentioned above the scheme operates under statutory provision: thus in Australia the Stevedoring Industry board was established by an act of 1949 and has the duty of maintaining the labour supply and of organizing and controlling waterside workers. In others, decasualization regulations are included in the collective agreements between employers and unions, and the system is thus anchored to the principle of collective bargaining. The guarantee of a minimum income is embodied in such schemes as those of Australia, France and New Zealand, in which workers receive attendance money and (in New Zealand) a guaranteed minimum wage. Some further remarks on these schemes will be found in the International Labour office report on *Decasualisation of Dock Labour* (1949). (A. F. Ws.)

#### UNITED STATES

The term casual labour, whether applied to demand for labour or to the people who satisfy the demand, is used in the United States to describe irregular, short-time employment of a wide variety of types. It ranges from extra help for house cleaning, snow shovelling and the like, to short-time hirings on docks and in agriculture, lumbering, contracting and other industries. Many thousands pick up a precarious livelihood at such work. Caterers, hotels and restaurants and clubs, hire casual labour for waiting table and kitchen work at banquets and other social functions; advertisers, theatres, stores and many other businesses employ people for short periods to distribute advertising matter, help load or unload trucks or other equipment, deliver merchandise or do odd jobs. A multitude of small businesses such as wood sawyers, house builders, coal and ice companies and canneries often hire short-time help. Those enumerated are illustrations of the wide range of casual jobs in the business world in general.

The United States bureau of the census enumerates, as one classification, people who involuntarily work part time. They cannot get or cannot accept steady work. The census bureau stated (Sept. 20, 1951; cf. bibliography) that "a disproportionate part of the involuntary part-time workers are employed in private household work where work schedules are notably unsteady irrespective of the economic climate in general." This group includes cleaning women who work by the day, men who spade gardens, clean and install storm windows, rake leaves, and do similar odd jobs around the home. Every city and town and many rural communities have casual workers depending upon such employment. In total, they are a large number of people.

A clear distinction must be made between casual jobs, i.e., jobs which create a demand for casual labourers, and casual labourers as such. Casual jobs are often accepted by people who are ordinarily in regular employment but who, during unemployment, seek casual work to tide themselves over a stringency. Casual labourers are people who consistently work irregularly. They depend for subsistence on picking up short jobs. They are often physically or psychologically incapable of steady employment. In a limited number of cases, they do casual work to supplement some other type of income. But in the large majority of cases, casual work is performed by casual labourers for whom it is their dependence for livelihood. These labourers are often deficient in work capacity; some are old or some physically deficient, or both. Most of them are below par physically and psychologically. They are a normal product of uncertain livelihood, too much unemployment, and often of demoralizing life experiences. Patterns of living which depend upon picking up odd jobs are seldom desirable socially or individually.

There is a twilight zone between mere part-time employment and casual employment. In individual cases it is frequently difficult to know whether to classify certain work as merely irregular or as casual. In agriculture, for instance, with its seasonal work, thousands of work opportunities of a definitely casual type arise. Harvesting of many crops which require much seasonal labour (such as picking fruit and berries, cultivating or harvesting green

vegetables, working in the onion fields in Texas, or in the sugar beet fields in Colorado, Michigan and other states) also call for a large number of people hired for very short periods, either to replace hands who have quit or to step up the job to a faster pace for a short time.

The loading and unloading of ships has been for centuries an outstanding type of casual employment (see above). The unceasing hiring, laying off and new hiring of longshoremen for the loading or unloading of ships; the former unpredictability of the arrival times of ships; and the daily uncertainty about both the day's demands for labour and the number of men available, kept the dock situation in a constant state of flux. The ease with which unemployed men from other industries could come to the docks to pick up a few dollars intensified the competition for work, while the labour surplus ordinarily accumulated around the docks played into the employers' hands. Large numbers of longshoremen frequently found themselves on poor relief.

The unionization of U.S. longshoremen, particularly from the early 1930s onward, enabled the longshoremen to prevent easy access to longshore work by refusing to work with nonmembers or requiring nonmembers accepted for employment to have union permits, thus establishing union control over the labour supply. They established "dispatching halls" (hiring halls) in many ports, supervised by a joint committee of employer and union representatives or by the union. The hiring-hall system, which began at Seattle, Wash., in 1939, did much to change the casual labour situation on the docks to a regularized system of employment. The halls enabled the longshoremen to hold the dock work for those who made it their regular occupation and to divide the available work equitably among them. It insured the employers experienced men systematically dispatched to the boats as needed. The system did not work without frictions, disputes and delays in the handling of shipping, but it markedly diminished the casual character of longshore work.

The relatively full employment which prevailed in the years after 1941 did more than anything else to counteract casual employment. With industry, mining, transportation and agriculture all operating at a high level of productivity, there were more opportunities for workmen of less than maximum efficiency to get steady employment and a noticeable reduction in the proportion of casual workers in the industrial population.

**BIBLIOGRAPHY.**—The Governor's Committee to Survey the Agricultural Labor Resources of the San Joaquin Valley, *Agricultural Labor in the San Joaquin Valley: Final Report and Recommendations* (March 1951); Paul S. Taylor, "Perspective on Housing Migratory Agricultural Laborers," *Land Economics* (Aug. 1951); U.S. bureau of the census, *Current Population Reports: Labor Force*, Census Series P-50, No. 34 (Sept. 20, 1951); Joint Legislative Committee on Agriculture and Livestock Problems, *The Recruitment and Placement of Farm Laborers in California 1950*, (1951). (D. D. L.)

**CASUALTIES**, in military use, the losses of a force in war by death, wounds, sickness, desertion or any other cause (from Lat. *casus*, that which falls out). The duty of dealing with all casualties from wounds or sickness falls to the medical services, the personnel of which treats each case from the moment of its occurrence to the eventual recovery or death of the patient.

**CASUAL WARD**, the name given, under the British poor laws in force between 1834 and 1948, to a building for the purpose of giving temporary shelter to vagrants.

Under the poor law as reformed in 1834, the primary duty of boards of guardians was to relieve destitute persons within their districts. Gradually, however, it was extended to the administering of relief to vagrants, popularly called tramps and officially termed casual paupers. The casual ward was generally adjacent to the workhouse or poor law institution.

Any vagrant or unemployed person walking from place to place and seeking work usually obtained an order for the casual ward from the relieving officer or his assistant; vagrants were searched—usually perfunctorily—and deprived of money and tobacco which were restored to them on discharge. They were given a bath on admission and a meal, usually sugarless cocoa and a piece of bread. For the night the clothes of the inmates were taken away (and sometimes disinfected) and a rough nightshirt provided. Sleeping accommodation on the floor or a truckle bed was pro-

vided either in cell's or associated wards. In return for the food and lodging, tasks of wood sawing or chopping, digging, oakum picking or scrubbing floors were imposed, though in many of the wards the obligation was not too strictly enforced.

**Poor Law Act, 1930.**—After 1918 as a result of postwar conditions and industrial disputes the great increase in the numbers of wayfarers applying for assistance to the poor law guardians threw the system out of gear and, following the abolition of the boards of guardians by the Local Government act, 1929, and the transference of their functions to the county and borough councils, a reorganization was affected by the Poor Law act, 1930, supplemented by various orders. The provision of and admission to casual wards became the business of the public assistance committees of the councils, and joint vagrancy committees were established throughout the country to bring about a uniform system and effect economies in expenditure. The casual was admitted and supervised by trained officials, and ordinarily was not allowed to discharge himself before the second morning (excluding Sunday) following admission unless he had a current vacancy ticket given him by an employment exchange. (This was a card showing an appointment with a prospective employer, and entitled its owner to leave the casual ward immediately without detention.) His clothing was taken and cleaned if necessary; money and other articles were also taken from him and the cost of relief deducted before return; a day room and proper sleeping accommodation had to be provided, also a clean towel; and any case of infectious disease or mental illness had to be reported to the ministry by the medical officer, who had to visit the ward and examine every casual therein once a month.

**National Assistance Act, 1948.**—During World War II casual wards in England and Wales were closed. By the end of the war some had fallen into disrepair and some had been taken over permanently for other uses. Furthermore, between 1939 and 1945 the number of vagrants fell greatly; and though there appears to have been a steady increase in the years immediately after the war, the numbers, by the end of 1951, were apparently still far short of those in prewar years.

The 1948 act changed the administration of the casual wards. These, henceforward, to be known as "reception centres," were placed under the National Assistance board. The great majority of the centres (which were fewer in number than the old casual wards) were housed in the identical buildings which had previously been used for such wards. Shortage of materials had made it impossible to erect new buildings, though it would have been preferable to do so. Again, although the responsibility for these centres was transferred to the National Assistance board, the act empowered it to make local authorities its agents in carrying out these duties; and this it ordinarily does.

The regimen of the English casual ward between 1931 and 1939, summarized above, was followed in reception centres; but while the standing principle of the prewar poor law administration in England and Wales had been to keep the vagrant moving, the major change made by the 1948 act was that vagrants should be encouraged to stay at the centres until some constructive action could be taken for their benefit. (A. F. Ws.)

**CASUARIIDAE:** see CASSOWARY.

**CASUARINA**, a genus of odd trees of the Casuarinaceae family containing about 35 species, chiefly Australian, but a few Indo-Malayan. The long whip-like green branches are longitudinally grooved and bear at the nodes whorls of small scale-leaves, the shoots resembling those of *Equisetum* (horse-tail). The flowers are unisexual. The staminate are born in spikes, each flower consisting of a central stamen which is surrounded by two scale-like perianth-leaves. The pistillate are borne in dense spherical heads; each flower stands in the axil of a bract and consists of two united carpels flanked by a pair of bracteoles; the long styles hang out beyond the bracts, and the one-chambered ovary contains two ovules. In the fruit the bracteoles form two woody valves between which is a nutlet; the aggregate of fruits resembles small cones. Pollen is transferred by the wind to the long styles. The pollen-tube does not penetrate the ovule through the micropyle but enters at the opposite end—the chalaza. (see ANGIO-

SPERMIS). The wood is very hard, and several species are valuable timber trees. From a fancied resemblance of the wood to that of the oak these trees are known as "oaks," and the same species has different names in different parts such as "she-oak," "swamp-oak," "iron-wood" and "beef-wood." Several species are cultivated in the subtropical parts of the United States, especially the beef-wood (*C. equisetifolia*), which has become widely naturalized in Florida. See J. H. Maiden, *Useful Native Plants of Australia* (London and Sydney, 1889).

**CASUISTRY**, the art of bringing general moral principles to bear on particular actions. It is, in short, applied morality; anybody is a casuist who reflects about his duties and tries to bring them into line with some intelligible moral standard. But morality at different times has worn very different dresses. It has sometimes been thought of as an outward law, sometimes as an inward disposition; and each of these rival conceptions has developed a casuistical method of its own. Believers in law have put their trust in authority or logic; while believers in disposition chiefly look to our instinctive faculties—conscience, common-sense or sentiment. The legal is the older group, and to it the name of casuist is often exclusively reserved, generally with the implication that its methods are too purely technical to commend themselves to mankind at large. But common-sense and conscience are quite as definite guides as logic or authority; and there seems no good reason for refusing to give the name of casuistry to their operations.

The casuistry of primitive man is uncompromisingly legal. His morality is not yet separated from his religion; and religion for him means the cult of some superior being—the king or priest of his tribe—whose person is charged with a kind of sacred electricity. "His divinity is a fire, which, under proper restraints, confers endless blessings; but if rashly touched, or allowed to break bounds, it burns or destroys what it touches. Hence the disastrous effects supposed to follow a breach of taboo; the offender has thrust his hand into the divine fire, which shrivels up and consumes him on the spot" (Frazer, *The Golden Bough*, i. 169). Elaborate rules are accordingly drawn up to secure the maximum of benefit, and the minimum of inconvenience, from this sacred fire; and in the application of these rules does savage casuistry consist. At a higher stage of civilization the god is no longer present in person but issues to his worshippers categorical commands. These logic must seize upon and develop as far as they will go; for the breach of some trifling consequence of a rule might mean the loss of the deity's favour. Hence the rise of sacred books among most Eastern peoples. On the Jewish Decalogue, for instance, follows the law, and on the law the rabbinical schools. Some of these will be stricter, and some laxer; but on the whole all tend to "aggravate" the law—down to the point of forbidding the faithful to wear a girdle, or to kill a noxious insect on the Sabbath. Though indeed we might look nearer home than the Talmud for similar absurdities; most Puritan communities could furnish strange freaks of Sabbatarian casuistry. Nor have the Catholics been one whit behind them. Their scholastic doctors gravely discuss whether—since water is the "matter" of baptism—a soul can be made regenerate by milk, or rose-water or wine.

At the opposite pole stood ancient Greece. Here ceremonial casuistry found no place, because there were no sacred books. "Among the Greeks writing never attained the consecration of religion. No system of doctrine and observance, no manuals containing authoritative rules of morality, were ever transmitted in documentary form. In conduct they shrank from formulae. Unvarying rules petrified action; the need of flexibility, of perpetual adjustment, was strongly felt" (Butcher, *The Greek Genius*, p. 182). For this reason their interest in ethical speculations was all the keener; their great thinkers were endlessly engaged in settling what the relation ought to be between duty and self-interest. Ought one to swallow up the other—and, if so, which should prevail? Or was it possible to patch up a compromise between them? The great Stoic philosophers took the austere life, and held that duty should always and everywhere be our only law. But it was one thing to enunciate such magnificent theories in a lecture, and quite another to apply them in

the market-place. Casuistry came to the aid of average human nature—that is to say, pupils began to confront the master with hard cases taken from daily life. And more than one master was disposed to make large—even startlingly large—concessions to the exigencies of practice. This concrete side of moral philosophy came specially into evidence when Stoicism was transplanted to Rome. Cicero's *De Officiis* abounds in the kind of question afterwards so warmly discussed by Dr. Johnson and his friends. Is it ever right to tell a lie? May a lawyer defend a client whom he knows to be guilty? In selling my goods, is it enough not to disguise their shortcomings, or ought I candidly to admit them? Seneca even made the discussion of such problems into a regular discipline, claiming that their concrete character gave an interest in morality to those who had no love for abstractions; while they prevented those who had from losing themselves in the clouds. And M. Thamin maintains, that, if his heroes did not form great characters, at any rate they taught the Roman child to train its conscience. But, then, Cicero and Seneca took common-sense as their guide. They decided each problem on its merits, looking more to the spirit than to the letter, and often showing a practical sagacity worthy of Johnson himself. Quite in the great doctor's spirit is Cicero's counsel to his son, to hear what the philosophers had to say, but to decide for himself as a man of the world. Such advice could not be grateful to the philosophers themselves—then a definite professional class, not unlike the "spiritual directors" of a later Rome, who earned their bread by smoothing away the doubts of the scrupulous on all matters intellectual and moral. Their great weapon was their logic; and a logician, as Pascal says, must be very unfortunate or very stupid if he cannot manage to find exceptions to every conceivable rule. In their hands casuistry became the art of finding such exceptions. From the Greek sophists they borrowed ingenious ways of playing off one duty against another, or duty in general against self-interest—leaving the doubter the alternative of neglecting the one and being a knave, or neglecting the other and being a fool. Or else they raised a subtle distinction between the act and the intention. To get drunk for the sake of a drink was the mark of a beast; but wine was a powerful stimulant to the brain, and to fuddle oneself in order to think great thoughts was worthy of a sage. No doubt these airy paradoxes were not always seriously taken; but it is significant that a common Roman proverb identified "philosophizing" (*philosophatur*) with thinking out some dirty trick.

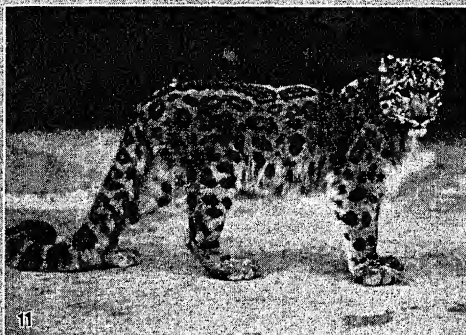
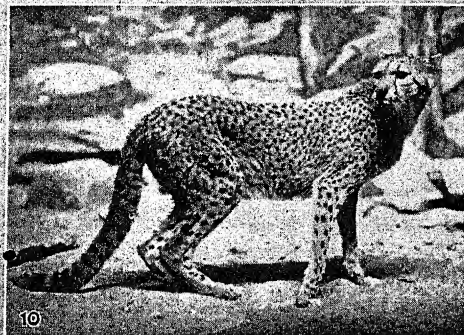
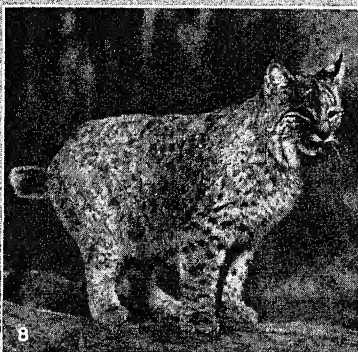
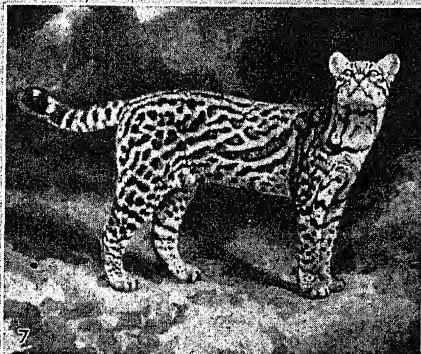
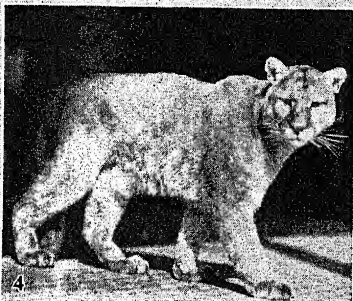
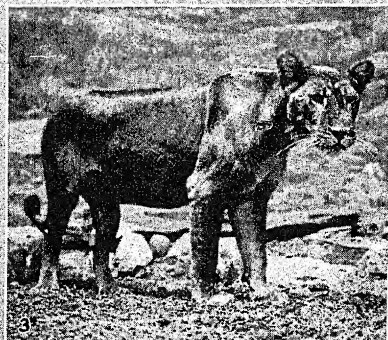
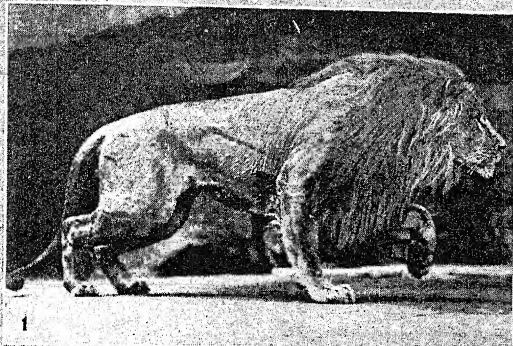
Christianity swept the whole discussion on to a higher plane. All the stress now fell on the disposition, not on the outward act. The good deeds of a just man were a natural consequence of his justice; whereas a bad man was no whit the better, because he now and then deviated into doing right. Actions, in short, were of no account whatever, apart from the character that produced them. "All things are lawful unto me," said St. Paul, "but all are not expedient." And St. Augustine sums the whole matter up in the famous phrase: "Have charity, and do as thou wilt." Narrow-minded Christian consciences, however, could not stay long on this level; law was so very much more satisfying a guide than vague, elusive charity. And law in plenty was forthcoming, so soon as the Church developed the discipline of public confessions followed by appropriate penances for each fault. At first the whole proceeding was informal and impulsive enough; but by the 7th century it had grown thoroughly stereotyped and formal. *Libri Poenitentiales* began to appear—detailed lists of all possible sins, with the forfeit to be exacted from each. As public penance finally decayed, and auricular confession took its place, these were superseded by the *Summae de Poenitentia*—law-books in the strictest sense. These were huge digests of all that popes, councils, Early Fathers had decided on every kind of question pertaining to the confessional—what exactly is a sin, what kind of questions the priest must ask, under what conditions he could give absolution. As such, they were eagerly welcomed by the clergy; for a single magistrate, sitting in secret without appeal, necessarily grasps at whatever will lighten his burden of responsibility. Nor was their complexity a stumbling-block. The mediaeval mind was only too prone to look on morality as a highly technical

art, quite as difficult as medicine or chancery law—a path where wayfaring men were certain to err, with no guide but their unsophisticated conscience. What could they possibly do but cling to their priest with a "blind and unexpressed faith"?

Against this state of things the Reformation was a violent protest. Catholicism increasingly took for granted that a man imperilled his soul by thinking for himself; Protestantism replied that he could certainly lose it, if he left his thinking to another. For it is to the individual conscience God speaks; through the struggles of the individual conscience He builds up a strong and stable Christian character. "A man may be a heretic in the truth," says Milton in his *Areopagitica* (1644), "if he believes things only because his pastor says so, or the Assembly so determines, without knowing other reason, though his belief be true, yet the very truth he holds becomes his heresy. There is not any burden that some would not gladly post off to another than the charge and care of their religion. A wealthy man, addicted to his pleasures and his profits, finds religion to be a traffic so entangled, and of so many piddling accounts, that of all mysteries he cannot skill to keep a stock going upon that trade. What does he therefore but resolve to give over toiling, and find himself some factor, to whose care and conduct he may commit the whole managing of his religious affairs—some divine of note and estimation that must be. To him he adheres, resigns the whole warehouse of his religion with all the locks and keys into his custody, and indeed makes the very person of that man his religion. So that a man must say his religion is now no more within himself, but is become a dividual moveable, which goes or comes near him, according as that good man frequents the house."

Twelve years after the *Areopagitica* appeared Pascal's *Provincial Letters* (1656-1657). These deal with the casuists of the Counter-Reformation in the spirit of Milton, laying especial stress on the artificiality of their methods and the laxity of their results. Not, of course, that they meant deliberate evil; Pascal expressly credits them with good intentions. But they were drawn, almost to a man, from Italy or Spain, the two countries least alive to the spirit of the Reformation; and most of them were Jesuits, the order that set out to be nothing Protestantism was, and everything that Protestantism was not. Hence they were resolutely opposed to any idea of reform; for to begin making changes in the Church's system would be a tacit admission that Luther had some show of reason on his side. On the other hand, they would certainly lose their hold on the laity, unless some kind of change were made; for many of the Church's rules were obsolete, and others far too severe to impose on the France of Montaigne or even the Spain of Cervantes. Thus caught between two fires the casuists developed a highly ingenious method, not unlike that of the Roman Stoics, for eviscerating the substance of a rule while leaving its shadow carefully intact. The next step was to force the confessors to accept their lax interpretation of the law; and this was accomplished by their famous theory of *probabilism*—first taught in Spain about 1580. This made it a grave sin in the priest to refuse absolution, whenever there was some good reason for giving it even when there were other and better reasons for refusing it. This principle does not deserve all the abuse that has been lavished upon it. It secured uniformity in the confessional, and thereby protected the penitent from the caprices of individual priests; and by depriving these of responsibility, it forced the penitent back on himself. But the gain was more than counterbalanced by the evil. The less the Church could expect from its penitents, the more it was driven to trust to the miraculous efficiency of sacramental grace. Once get a sinner to confession, and the whole work was done. However bad his natural disposition, the magical words of absolution would make him a new man. As for most penitents, all they cared for was to scrape through by the skin of their teeth. Casuistry might insist that it only proposed to fix the minimum of a minimum, and ~~had~~ them for their soul's sake to aim a little higher. Human nature seldom resists the charms of a fixed standard—least of all when it is applied by a live judge in a visible court. If the priest must be satisfied with little, why be at the trouble of offering more? For this reason, probabilism found vigorous opponents in

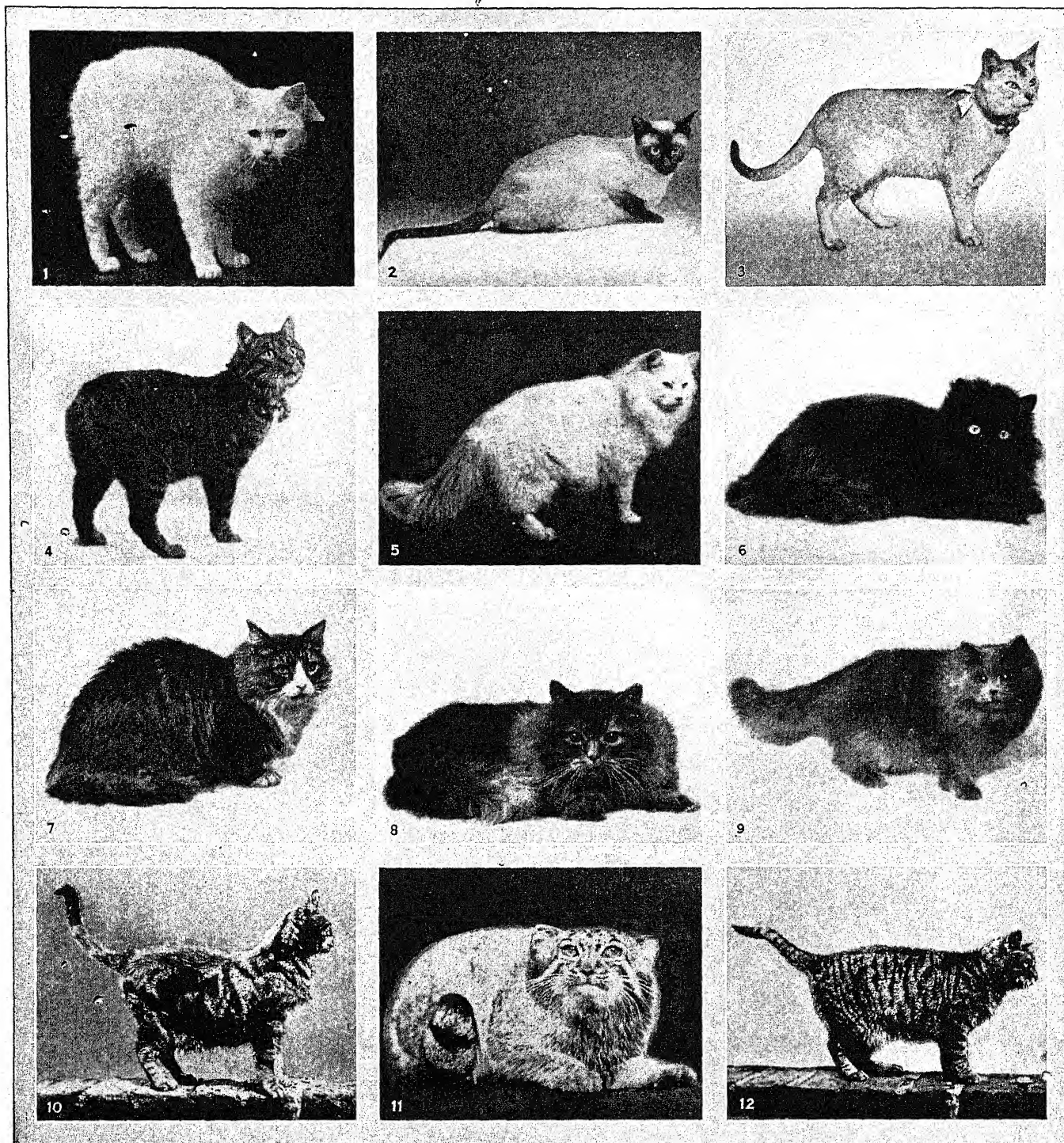




BY COURTESY OF (1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12) NEW YORK ZOOLOGICAL SOCIETY, (5) FROM CHAMPION, "WITH A CAMERA IN TIGERLAND" (CHATTO AND WINDUS, LONDON; DOUBLEDAY, GORAN & CO., INC., NEW YORK)

#### MEMBERS OF THE CAT FAMILY FOUND IN AFRICA, ASIA AND AMERICA

1. Lion (*Panthera leo*), one of the two largest of the cat family, the other a tiger. It is found in Africa, Mesopotamia, Persia and India
2. The Bengal tiger (*Panthera tigris*), a fierce beast of prey which sometimes, especially in old age, becomes a man-eater
3. Lioness (*Panthera leo*), about a foot shorter than the adult male and generally considered more dangerous when attacked
4. Puma or mountain lion (*Felis concolor*), a large American cat extensively distributed from Canada to Patagonia. It is of a uniform colour
5. Tigress (*Panthera tigris*), somewhat smaller than the male but equally aggressive, especially when protecting her young
5. Leopard cat (*Felis bengalensis*), a small, savage wildcat of tropical Asia that feeds largely on game birds
7. Ocelot (*Felis pardalis*), an American forest cat ranging from Texas to Paraguay. Its fur is yellow or grey marked with spots
8. The red or bob-tail lynx (*Lynx rufus*), a North American species that ranges south to Mexico. Its reddish summer coat is less spotted
9. Jaguar (*Panthera onca*), the largest of American cats. It ranges from Texas to Patagonia and sometimes develops into a man-eater
10. Cheetah or Hunting Leopard (*Acinonyx jubata*), so called because it is used in the hunting of game. It is a native of Africa and Asia
11. The snow-leopard (*Panthera uncia*), an inhabitant of highland Central Asia. Its name is suggested by its grey spotted fur
12. Serval (*Felis serval*), an African wildcat that preys on small quadrupeds and is prized by the natives for its skin, which is a spotted yellow



BY COURTESY OF (3, 4) HELEN HILL SHAW, (8) GERTRUDE E. TAYLOR; PHOTOGRAPHS, (1, 2, 6, 7) THOMAS FALL COPR., (5, 9) THE KEYSTONE VIEW COMPANY, (10, 12) TOPICAL PRESS AGENCY, (11) W. G. BERRIDGE

# DOMESTIC CATS

- |   |  |                               |
|---|--|-------------------------------|
| 1. White Manx (tailless) cat, Champion Chelsea, "Villish Mona Veen" | 4. Striped Manx cat  | 8. Red Tabby Persian cat      |
| 2. Siamese cat, Champion "Simple"                                   | 5. White Persian cat, "Morvich," owned by Mrs. J. H. Clark | 9. Blue Persian cat           |
| 3. Abyssinian (silver) male cat, owned by Mrs. Carew-Cox            | 6. Black Persian, Champion "Sally Girl"                    | 10. Blotched domestic cat     |
|   | 7. Tabby cat   | 11. The manul or Pallas's cat |
|   |  | 12. Striped domestic cat      |



Bossuet and other eminent divines; and various of its excesses were condemned by the popes during the latter half of the 17th century. After a long eclipse it was finally re-established, though in a very modified form, by Alfonso Liguori about the middle of the 18th century.

In Protestant countries casuistry shrank and dwindled, though works on the subject continued to be written both in Germany and England during the 17th century. The best known of the Anglican books is Jeremy Taylor's *Ductor Dubitantium* (1660). But the Protestant casuist never pretended to speak authoritatively; all he did was to give his reasons, and leave the decision to the conscience of his readers. "In all this discourse," says Bishop Sanderson, one of the best of the English writers, "I take it upon me not to write edicts, but to give my advice." Very soon, however, these relics of casuistry were swept away by the rising tide of common-sense. The 18th century loved to discuss hard cases of conscience, as a very cursory glance at Fielding's novels (1742-1751) or Boswell's *Life of Johnson* (1791) will show. But the age was incurably suspicious of attempts to deal with such difficulties on any kind of technical system. Pope was never tired of girding at

Morality by her false guardians drawn,  
Chicane in furs, and casuistry in lawn.

while Fielding has embodied the popular conception of a casuist in Parson Thwackum and Philosopher Square, both of whom only take to argument when they want to reason themselves out of some obvious duty. Still more outspoken is the Savoyard vicar in the *Émile* (1762) of Jean Jacques Rousseau: "Whence do I get my rules of action? I find them in my heart. All I feel to be good is good; all I feel to be evil is evil. Conscience is the best of casuists; it is only when men wish to cheat it that they fly to logical quibbles." Extravagant as this sentiment sounds, it paved the way to better things. The great object of 17th-century moralists had been to find some general principle from which the whole of ethics could be deduced; common-sense, by turning its back on abstract principles of every kind, forced the philosophers to come down to the solid earth, and start by enquiring how the world does make up its mind in fact. During the last two centuries deduction has gone steadily out, and psychology come in. Ethics has become more distinctively a science, instead of an awkward hybrid between a science and an art; its business has been to investigate what moral conduct is, not to lay down the law as to what it ought to be. Hence they deliberately refuse to engage in casuistry of the old-fashioned sort. Further, it is increasingly felt that ethical judgments do not depend on reason alone, but involve every element in our character; and that the real problem of practical morality is to establish a harmonious balance between the intelligence and the feelings—to make a man's "I think this is right" correspond with his "I feel that it is so." Whether systematic training can do anything to make the attainment of this balance easier is a question that has lately engaged the attention of many educational reformers; and whatever future casuistry may still have before it would seem to lie along the lines indicated by them.

There is an excellent study of the ancient casuists by M. Raymond Thamin, *Un Problème moral dans l'antiquité* (1884). For the Roman Catholic casuists see Döllinger and Reusch, *Moral-Streitigkeiten im siebzehnten Jahrhundert* (Nordlingen, 1889), and various articles ("Casuistik," "Ethik," "Moralsysteme," etc.) in Wetzzer and Welte's *Kirchenlexicon* (Freiburg, 1880-96). See also the editions of Pascal's *Provincial Letters*, by John de Soyres (with English notes, Cambridge, 1880), and A. Molinier (Paris, 1891). The Anglican casuists are discussed in Whewell, *Lectures on Moral Philosophy* (1862). For general reflections on the subject see the appendix to Jowett's edition of the *Epistle to the Romans* (1855). Most modern text-books on ethics devote some attention to the matter—notably F. H. Bradley in his *Ethical Studies* (1927). See also Hastings Rashdall, *Theory of Good and Evil* (Oxford, 1907). (Sr. C.)

**CASUS BELLI**, an act or omission which, if not rectified, may justly be remedied by war. Interference with the full exercise of a nation's rights or independence, an affront to its dignity, an unredressed injury, are instances of *casus belli*. • (See ARBITRATION, INTERNATIONAL.)

**CAT**, the name of the well-known domesticated animal *Felis catus*, but in a wider sense employed to denote all the more typical members of the family Felidae. The word "cat" is also applied to other objects, in all cases an application of the name of the animal. In mediæval siegecraft the "cat" was a movable pent-house used to protect besiegers when approaching a wall or gateway.

"Cat" or "cat-head," in nautical usage, is the projecting beam on the bow of a ship used to clear the anchor from the sides of the vessel when weighed. The name is also used for a type of vessel, formerly used in the coal and timber trade in northeast England; it is still applied to a small rig of sailing boats. • The instrument of punishment, generally called the "cat o' nine tails," consists of a handle of wood or rope, about 18 in. long, with nine knotted cords or thongs.

**Origin of the Domestic Cat.**—Although bones of cats were found in the dwellings of ancient cavemen, it is very probable that these cats were not domestic. About 3000 B.C. in Egypt, when agriculture had become well established, the Egyptians tamed the cat to protect their stores of grain. These animals proved so valuable that they were later considered to represent one of the gods, perhaps to give cats better protection. The wild species from which they were derived was the African wild cat (*Felis lybica*), one race of which occurred in Egypt. This is a gray cat with a slightly buffy cast, marked with blackish stripes and spots on the body and legs, the tail with a black tip and several rings, and the feet dusky. Its hair is short and the build and general proportions are like those of the common house cat. • Modern domestic cats interbreed freely with the African wild cat.

From Egypt domestic cats spread slowly throughout the civilized world. In Europe they undoubtedly interbred with the European wild cat (*Felis silvestris*), a very closely related species with longer fur and tail. In the Egyptian wild cat the pads of the toes are wholly black, and the black extends up to the heel. In the European wild cat, on the other hand, the black is limited to a small round spot on the pads. In domestic cats with wild colouring the soles of the hind feet correspond in this particular with the Egyptian wild cat.

Two distinct types of so-called tabby cats are recognized. In one the pattern consists of narrow, vertical stripes and in the other of longitudinal or obliquely longitudinal stripes, which, on the sides of the body, tend to assume a spiral or whirl arrangement. One or other of these types is to be found in cats of almost all breeds, and there appear to be no intermediate stages. The striped type is the wild pattern of both European and African wild cats; but the origin of the blotched pattern was probably a mutation.

Tame cats from Egypt were imported into Italy at an early date by Phœnician traders and became established long before the Christian era. Their progeny spread over Europe, more or less crossed with the indigenous species. Remains of cats found in Roman villas at Silchester and Dursley are probably referable to the domesticated breed. The earliest record in Great Britain dates from about A.D. 936 when Howel Dda, prince of south central Wales, enacted a law for their protection.

There are fewer breeds of domestic cats than there are of dogs, and the differences are not so great as those shown in the various breeds of rabbits. Except in a very few cases there is no need to suppose crossing with other species to explain the peculiar characters of certain cats.

All animals are liable to show individual variation which can be selected and established in pure strains. Larger mutations occur rarely but are likely to make their appearance from time to time.

**Breeds of Domestic Cats.**—Apart from the division on the basis of their pattern, mentioned above, domestic cats are divided into short-haired and long-haired groups. The former resemble the wild cats of Europe and Africa, the long-haired types having developed in Persia and Afghanistan. Cats of both groups vary, on the one hand, toward melanism, black colouration like that seen in many wild species of cats, while on the other hand white cats are fairly common. A nearly white tiger and a similarly coloured cheeta have been reported, and an albino leopard is known.

but albinism is very rare among all species of *Felidae*. Tortoiseshell cats are generally females with a mixed colour of black and yellow (and white); yellow or sandy cats are usually males. The genetic factors for red and black are thought to be situated in the sex chromosomes, which accounts for the peculiar inheritance of these colours.

There are two varieties of the long-haired cats, the Angora and the Persian. The former has a pointed head, long nose, and long, silky fur. The Persian (which may come from Afghanistan) has a rounded face and coarse fur; its tail is thickest near the tip. In the United States and parts of Europe the latter cat has replaced the Angora. These long-haired cats are often thought to have been derived from the manul (*Felis manul*) of the steppes of central Asia, but long-haired breeds of goats, rabbits and dogs indicate that it is not necessary to suppose such an unlikely ancestry.

The tailless or Manx cat, in which the tail may be represented merely by a tuft of hair without any bone, is common in the far east. In the Malay regions and Philippines normal long-tailed cats are rarely seen, and kink-tailed or short-tailed cats predominate. Whether the tailless cat reached the Isle of Man from elsewhere or whether it developed there as a sudden independent mutation is not known. The fur is usually longer and more lax than in ordinary cats. In New England and the middle Atlantic states they are often called "rabbit cats," and people suppose they are part rabbit, incredible as such a crossing would be. The cry is said to differ somewhat from that of tabby cats.

Among the domestic cats of India, spotted colouring, much like that of the Indian desert cat (*Felis constantina ornata*) is common. This cat is a close relative of the African wild cat, and crossing between it and domestic cats is quite possible.

The Abyssinian breed is characterized by lack of spots and stripes on the body, each hair being "ticked" like that of a wild rabbit (known to geneticists as agouti). The head and neck retain the typical markings of the African wild cat and the tail ends in a black tip. The colour is typically reddish brown. The fur is short, the ears relatively large and occasionally tipped with long hairs. Ordinary striped tabbies sometimes produce kittens with this type of colouration, and there is little question but that this breed originated entirely from the African wild cat, probably through the Egyptian cat.

By far the most remarkable of the domestic breeds is the Siamese cat. It was first imported into England in 1884 and reached the U.S. in 1895; it became popular and numerous in both countries. Siamese cats often have kinky tails and cross-eyes, defects which breeders have not been able to eliminate from the strain. The head is rather long and pointed, the body also elongate, the hair sleek and short, and the eyes blue. The general colour is cream or buffy, with the face, ears, paws and tail dark chocolate-coloured in a variety in which the eyes are yellow. The young are white. Temperature modifies the development of the colour, less blackish developing under warm conditions, while in cold the entire animal darkens more than normally. The Siamese type of colouration is known in rabbits and other animals, in which it is often called "Himalayan." In the several thousand years cats have been in Siam, the mutation undoubtedly appeared and was fixed by selection and careful breeding. After 1924, several strains of long-haired Siamese cats were produced scientifically by crossing with Persians and inbreeding.

Numerous clubs have been founded in Europe and North America to encourage the breeding of cats and to promote cat shows. Short-haired breeds are rather easy to manage, but the long-haired varieties need more care and when shedding are nuisances.

**European Wild Cat.**—The wild European species, *F. silvestris*, conforms closely in pattern to the striped phase of domestic tabby but is brownish gray or buffy. The hair of the tail is long, especially toward the tip, which gives a club shape to this member. The geographical range of the wild cat formerly included Great Britain, central and southern Europe, and portions of central Asia. It is now, however, much reduced in numbers and it is doubtful if it is found anywhere without at least a trace of the domestic form in its constitution. In Great Britain wild cats sur-

vive only in some Scottish forests. Remains of the wild cat occur in English caverns; in Ireland the wild species has apparently been unknown during the historic period.

The favourite haunts of the wild cat are mountain forests where rocks or cliffs are interspersed with trees. Crevices in the rocks or the hollow trunks of trees afford sites for the lairs, where the young (2 to 5) are produced and reared. The kittens, usually born in May, are at first blind, although furred. Wild cats are described as some of the most ferocious and untamable of all animals. How far this lends support to the view of the origin of our domestic breeds is uncertain. Hares, rabbits, field mice, water rats, rats, squirrels, moles, game birds, pigeons, and small birds form the chief food of the wild cat, while fawns of roe deer are sometimes killed.

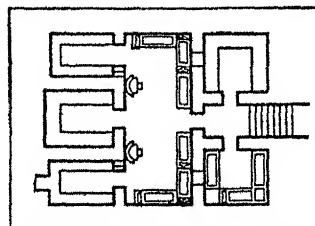
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**CATAclysm**, a great flood (Gr. κατακλυσμός, a deluge). In geology an overwhelming catastrophe producing sudden changes in the earth's surface; figuratively, any violent change that sweeps away the existing social or political order.

**CATACOMBS.** Tombs hewn in solid rock were used by the Etruscans as independent family burial places, grouped together. They often rise in the hillside by tiers or are on the same level branching off into streets and alleys. Their plan is for the most part that of a house and the walls are often covered with paintings in an archaic style in red and black. At Poggio Gaiella, near Chiusi, the ancient Clusium, is a cemetery with a sepulchral chamber containing a large hall about 25 ft. in diameter supported by a cylindrical rock pillar. Opening out of this and other chambers are low winding passages, just large enough for a man to creep through, and this tomb has been surmised to be that of Lars Porsena, king in his day of Etruria (see fig. 2).

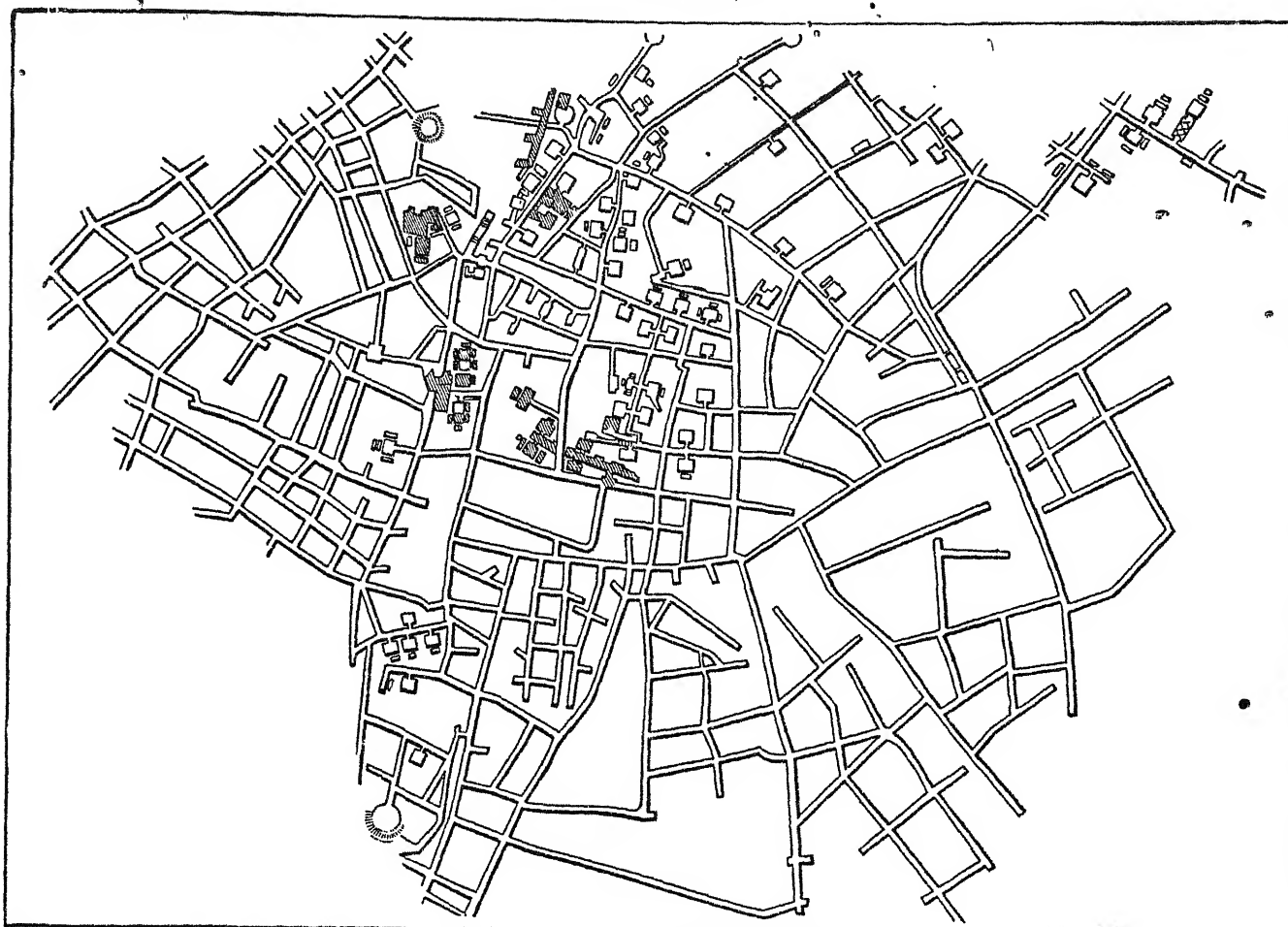
In the days of the republic inhumation was general and the bodies of the Scipios and the Nasos were buried in still existing catacombs, the term applied by transference to subterranean excavations for the interment of the dead. Originally it designated the natural configuration—in hollows—of a district close to the Appian way (see *ROME*). In the vaults below the church of St. Sebastiano lay, according to tradition, the bodies of the apostles St. Peter and St. Paul for seven months until removed to the basilicas which bear their names. The place became an object of pilgrimage and its name κατακυμβας, "by the hollow," developed as a generic name for all burial places of the same kind.

Rome is built upon a rock and the three strata named by geologists *tufa litoide*, *tufa granolare* and *pozzolana* have all been exploited. The *tufa litoide* is quarried as building stone. The catacombs of Rome—the most extensive known—are constructed in this stratum alone as it enabled the engineers to form vertical



FROM DENNIS  
FIG. 1.—PLAN OF ETRUSCAN TOMB  
AT CERVETRI

walls for the galleries in which the dead were placed and to work with comparative ease. The pozzolana used as an ingredient for mortar was worked from the lowest stratum so that in spite of old erroneous persistent beliefs the burial places are distinct from the pozzolana, excavated in different strata, though here and there starting from the same level. The catacombs form a vast labyrinth of narrow galleries usually from 3 to 4 ft. wide with small chambers at intervals, excavated at successive levels (fig. 1). The dead are buried in the galleries in long horizontal recesses in the walls, tier upon tier, even to 12 ranges. The galleries generally run in straight tiers, at the same level, in storeys (seven in one part of the cemetery of S. Calixtus), and intersect at various angles (see fig. 3). The graves (*loculi*) were usually parallel to

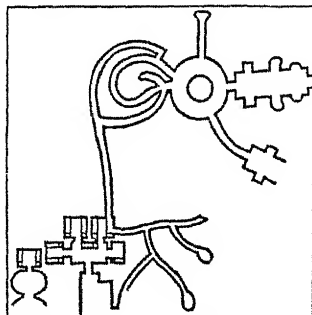


FROM HARTIGNY

FIG. 3.—PLAN OF PART OF THE CEMETERY OF S. AGNESE AT ROME

the gallery in Christian cemeteries, but in pagan areas the recess was usually at right angles. Some loculi held four or more bodies, most held one (fig. 5). They were carefully closed by slabs of marble or huge tiles cemented together. When an epitaph was set up, it was painted or engraved on these tiles. Table tombs and arched tombs are also found. Sarcophagi are rare. The family vaults—cubacula—were small apartments, usually rectangular, sometimes circular or polygonal, opening from the main corridors and frequently ranged regularly along the sides of the galleries. Loculi were cut for later burials in the same family area and the inscriptions and mural decorations were frequently damaged or destroyed. The funeral feast was celebrated by the family in its vault, both on the day of burial and on the anniversary. The Eucharist, the invariable accompaniment of funerals in the early Christian Church, was celebrated here, and in some of the catacombs are larger halls and connected suites of chapels which may have been constructed for congregational worship in the days of persecution (fig. 4). Baptisteries have been discovered. The catacombs were also used as places of refuge, for which they were admirably adapted, both by the intricacy of their design and by access through secret passages to sand quarries and the open country.

Almost without exception they had their origin in small burial areas, the property of private persons, and the great development was due to the spread of Christianity and the burial of the



FROM DENNIS

FIG. 2.—PLAN OF A PORTION OF THE PRINCIPAL STOREY IN THE POGGIO GAIELLA CEMETERY

dead in this manner conformed to Roman usage. There was no reason for secrecy and since interment in rock-hewn tombs had been practised in Rome by Jewish settlers before the rise of the Christian Church, the practice may well have been popularly, perhaps correctly, associated with the Jewish population which contributed elements to the new religious order. At a later period the grave diggers seem to have acquired or to have established a kind of property in the catacombs and to make new graves recklessly destroyed the religious paintings on the walls. The major part of the catacombs belong to the 3rd and early part of the 4th centuries. By A.D. 354 when St. Jerome visited them, interment in them had become rare. By the time of Pope Damasus (A.D. 366–384) they had become the resort of pilgrims. They were adapted to this by the orders of the pope. The works of art were restored. The epitaphs were renewed. In this latter work he employed an engraver named Furius Philocalus whose work can be recognized at once.

As a result the improvements described have lessened the value of the catacombs as memorials of the religious art of the 2nd and 3rd centuries. Subterranean interment ceased with the sack of Rome by Alaric in A.D. 410. The catacombs shared in the destruction of Rome by the Goths in the 6th century and by the Lombards at a later date. Pope Paul I. and Pope Pascha I. found them in such decay and pollution that the holy relics they contained were translated elsewhere and the catacombs soon ceased to attract pilgrims. By degrees their existence was forgotten and they were discovered by chance in 1578 and have been studied, explored, investigated and described by scholars such as Baronius, Antonio Bosio (d. 1629), Marc Antonio Boldetti (c. 1720), Séroux d'Agincourt (1825) Raoul Rochette and most notably in recent times by Father Marchi of the Society of Jesus. Additions to our knowledge have been made by de Rossi and include the re-discovery near the catacomb of Priscilla, on the Via Salaria Nuova,

of the Cosmeterium Jordanorum, first found in 1578 but soon afterwards choked up and lost. It is possible now to identify the tombs of martyrs like Nereus and Achilleus, said to have been baptized by St. Peter, who with their mistress Petronilla, of the Aurelian family and the spiritual daughter of St. Peter, suffered death for their faith under Domitian. Many of the names of persons mentioned in the Epistles of St. Paul are found here and every fresh excavation yields similar evidence.

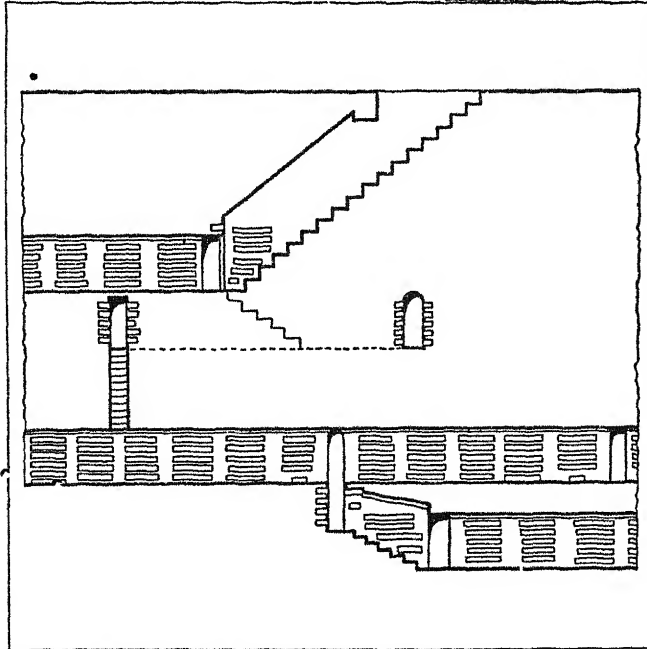


FIG. 4.—SECTION OF GALLERIES AT DIFFERENT LEVELS IN THE CATACOMBS OF ROME

At Syracuse there are very extensive catacombs known as "the Grottos of St. John." There is an entire underground city with several storeys of larger and smaller streets, squares and cross ways cut out of the rock; at the intersection of the cross ways are great circular halls of a bottle shape, like a glass-house furnace, lighted by air shafts. The galleries are generally very narrow, furnished on each side with arched tombs, and communicating with family sepulchral-chambers closed originally by doors, the marks of the hinges and staples being still visible. The walls are in many places coated with stucco adorned with frescoes including palms, doves, *labara* and other Christian symbols. This cemetery differs widely in arrangement from the Roman catacombs.

The catacombs at Malta are near the ancient capital of the island. The passages were all cut in a close-grained stone, and are very narrow, with arched ceilings, running very irregularly, and ramifying in all directions. The greater part of the tombs stand on either side of the galleries in square recesses (like the table-tombs of the Roman catacombs) and are rudely fashioned to imitate sarcophagi. The interments are not nearly so numerous as in other catacombs, nor are there any vestiges of painting, sculpture or inscriptions. At Taormina in Sicily is a Saracenic catacomb, also figured by Agincourt. The main corridor is 12 ft. wide, having three or more ranges of *loculi* on either side, running longitudinally into the rock, each originally closed by a stone bearing an inscription.

In Egypt we find a small Christian catacomb at Alexandria. The *loculi* here also are set endways to the passage. The walls are abundantly decorated with paintings, one of a liturgical character. But the most extensive catacombs at Alexandria are those of Egypto-Greek origin, from the largest of which, according to

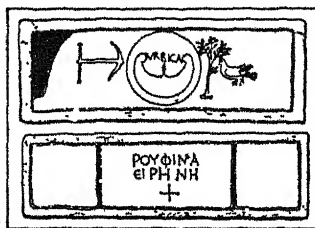


FIG. 5.—LOCULI IN CATACOMBS OF ROME. GRAVES OF URBICA AND RUFINA

Strabo (lib. xvii. p. 795), the quarter where it is placed had the name of the Necropolis. The plan is remarkable for its regularity (fig. 8). Here, too, the graves run endways into the rock. There are other catacombs in the vicinity of the same city.

Subterranean cemeteries of the general character of those described are very frequent in all southern and eastern countries. A vast necropolis in the environs of Saida, the ancient Sidon, consists of a series of apartments approached by staircases.

**Recent Discoveries.**—At Rome, after the death of de Rossi (1894) a small subterranean basilica in the catacomb of SS. Peter

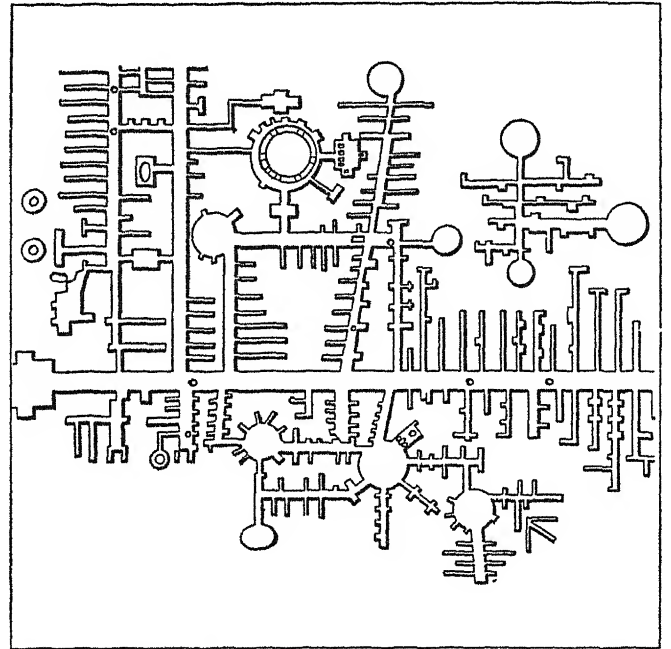


FIG. 6.—THE PLAN OF THE CATACOMB OF S. JOHN, SYRACUSE

and Marcellinus on the Via Labicana, with pious acclamations on the plaster similar to those in the Papal crypt in St. Calixtus was discovered in 1896. In the cemetery of Domitilla in 1897-1898 a fine double crypt with frescoes representing Christ seated between six male and female saints and an inscription relating to a new saint (Eulalius) in a cubiculum of the 3rd century was brought to light. In 1899-1900 were discovered two opposite cubicula in the catacomb of SS. Peter and Marcellinus, both covered with frescoes, the vault being in one case decorated with the scene which represents Christ seated among the apostles and pronouncing sentence upon the defunct. An inscription discovered in 1900 on the site of the ancient cemetery of St. Ciriaca, and dating from A.D. 405, states that one Euryalus bought a site *ad mensam beati martyris Laurentii* from a certain *fossor* whose name has been erased, an example of what was known as *memoriae damnatio*, or the blotting out of a name on account of some dishonourable action. In 1901-1902 excavations in the cemetery of Santa Priscilla, near the Cappella Greca, revealed a polygonal chamber which may have originally been the *nymphaeum* of the great villa of the Acilii Glabrones. It may have been used as a burial-place for martyrs, and as the sepulchral chapel of Pope Marcellinus, who died in A.D. 304 during the persecutions of Diocletian. In 1902, in that part of the Via Ardeatina which passes between the cemeteries of Calixtus and Domitilla, was discovered a crypt with frescoes and the sanctuary of a martyr; this, rather than a neighbouring crypt brought to light in 1897, may prove to be the sepulchral crypt of SS. Marcus and Marcellianus. In a cubiculum leading out of a gallery

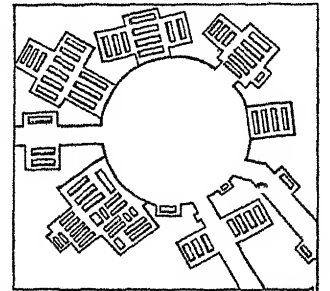


FIG. 7.—PLAN OF CIRCULAR HALL IN CATACOMBS OF S. JOHN, SYRACUSE



in the vicinity there was also discovered an interesting impression in plaster of an inscription of the mother of Pope Damasus, beginning:

*Hic Damasi Mater Posuit Lauren (tia Membra).*

In the same year building operations in the Via di Sant' Onofrio revealed the presence of catacombs beneath the foundations: examination of the *loculi* showed that no martyrs or illustrious

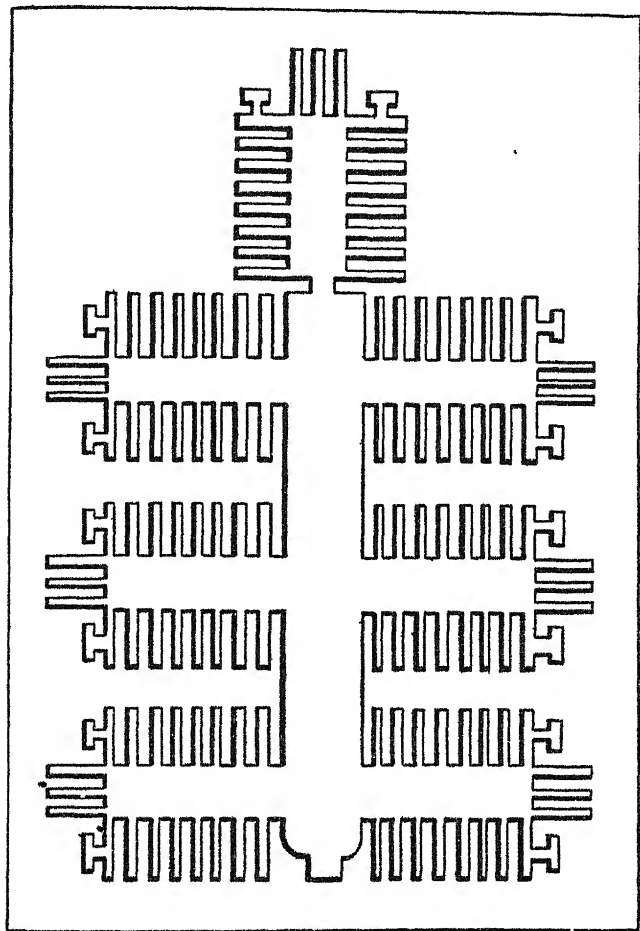


FIG. 8.—PLAN OF CATAOMB AT ALEXANDRIA

persons were buried there. Work was also carried out at the catacomb of Albano (Marucchi *Nuovo Bull.*, 1902, pp. 89 ff.).

In 1903 a new cemetery with frescoes came to light on the Via Latina, considered by Marucchi to have belonged to a heretical sect. In the same year the Jewish cemetery on the Via Portuense, was rediscovered. The subterranean basilica of SS. Felix and Adauctus, discovered by Boldetti and afterwards choked up with ruins, was cleared again: the crypt, begun by Damasus and enlarged by Siricius, contains frescoes of the 6th–7th centuries. In the same year extensive catacombs were revealed on the site of Hadrumetum near Sousse in Tunisia.

In 1907–08 interesting discoveries were made in the South East of Sicily (P. Orsi, *Notizie degli Scavi*, 1908). The year 1911 witnessed the discovery of the remarkable *hypogeum* of Trebius Justus on the Via Latina, with frescoes showing gnostic influence (*Nuovo Bull.* 1911 and 1912). In 1912 a catacomb was found at Grottaferata which has since been excavated by the Basilian monks. In 1915–1916 a *memoria* of SS. Peter and Paul was explored beneath the basilica of S. Sebastiano, *Ad catacumbas*, on the Appian way. *Graffiti* with invocations to these apostles, dating from the fourth century were discovered (Marucchi, *Nuovo Bullettino*, 1916, 1917, 1919, 1920). In 1917 was found subterranean basilica of the first century, perhaps the work of a pagan *sodalitas* (g. Bagnani, *Journ. of Roman Studies*, 1919, p. 78). In 1919, not far from the Porta Maggiore and the ancient Via Labicana, a *hypogeum* with two frescoed chambers was dis-

covered. The subjects were unusual; one, Christ instructing his sheep from a book recalled a passage in the inscriptions of Abercius in the Lateran; others were scenes from the story of Job diverging from those usual in the Catacombs; a group of 12 figures, perhaps apostles, including two recalling the traditional types of SS. Peter and Paul (Marucchi, *Nuovo Bull.* 1921). The year 1921 witnessed the rediscovery near the catacomb of Priscilla on the Via Salaria Nuova, of the *Coemeterium Iordanorum*, first found in 1578 but soon afterwards choked up and lost (Marucchi and Josi, *Nuovo Bull.* 1922).

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For accounts of the catacombs see:—Armellini, *Gli Antichi Cimiteri cristiani di Roma e d'Italia* (Rome, 1893); O. Marucchi, *Le Catacombe romane* (Rome, 1903; also translated into French), *Manuale di epigrafia cristiana* (Milan, 1904); M. Besnier, *Les Catacombes de Rome* (Paris, 1909); F. X. Kraus (*Realencyklopädie und Geschichte der christlichen Kunst*) and Dom F. Cabrol's *Dictionnaire d'archéologie chrétienne et liturgie*, articles with bibliography, by H. Leclercq.

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Works written in English are: Northcote and Brownlow, *Roma sotterranea* (London, 1869; based upon De Rossi); Wharton Marriott, *The Testimony of the Catacombs* (1870); J. H. Parker, *The Archaeology of Rome: the Catacombs*; Smith and Cheetham, *Dictionary of Christian Antiquities*, s.v. "Catacombs"; R. Lanciani, *Pagan and Christian Rome* (1892); W. Lowry, *Christian Art and Archaeology*, ch. ii. (1901; a useful introduction to the subject); H. Gee, "The Church in the Catacombs," in W. Lefroy's *Lectures in Ecclesiastical History* (1896); Th. Mommsen, in the *Contemporary Review* (May 1871).

The catacombs at Naples are described in C. F. Bellermand, *Über die ältesten christlichen Begräbnisstätten und besonders die Katakomben zu Neapel* (Hamburg, 1839); Armellini, as above and V. Schultze, *Die Katakomben von San Gennaro dei Poveri in Neapel* (Jena, 1877).

For the catacombs in Malta, A. A. Caruana, *Ancient Pagan Tombs and Christian Cemeteries in the Islands of Malta* (Malta, 1898), and A. Mayr, "Die altchristlichen Begräbnisstätten auf Malta," in *Römische Quartalschrift*, vol. xv, pp. 216 and 352 (Rome, 1901), and E. Becker, *Malta Sotterranea* (Strasbourg, 1913), may be consulted.

The fullest accounts of the Sicilian catacombs are given by J. Fuhrer, *Forschungen zur Sicilia sotterranea* (Munich, 1897); C. Barreca, *Le Catacombe di San Giovanni in Siracusa* (Syracuse, 1906); J. Fuhrer and V. Schultze, *Die altchristlichen Grabstätten Siziliens* (Berlin, 1907); and P. Orsi, *Per la Siracusa Sotterranea* (Catania, 1906).

A catacomb of the 5th century, discovered at Kertch on South Russia, is described by J. Kulakovsky in *Materials for Russian Archaeology* (St. Petersburg, 1896; a publication of the Russian Imperial Archaeological Commission), but it is written in Russian, as also is the account by V. Latyshev, in *Vizantieski Vremennik*, vol. vi, pp. 337 ff. (St. Petersburg, 1899).

The catacombs at Hadrumetum (Sousse) are described by A. F. Leynaud, *Les Catacombes d'Hadrumète, deuxième campagne de fouilles* (1904–1905). See also *Revue Tunisienne* (1905), p. 250.

For the catacombs of Alexandria, de Rossi in *Bull. di archeologia Cristiana* (Nov. 1864, Dec. 1865); Neroutsos Bey, *L'Ancienne Alexandrie* (W. R. B.; O. M. D.).

**CATAFALQUE**, a word of unknown origin, occurring in various forms in many European languages, meaning a funeral scaffold or temporary stage; a movable structure of wood, sometimes richly decorated, erected temporarily at funeral ceremonies in a church to receive the coffin or effigy of the deceased; also an open hearse or funeral car.

**CATALAN**. It is generally assumed that Catalan was imported from Roussillon into Spain during Carolingian times; the contrary view has, however, been put forward, namely that Catalan originally developed in Spain and was introduced into Cerdagne and Roussillon by Catalan immigration. Whatever the truth may be, philologically Catalan is to be regarded asertain-

ing to the Provençal rather than to the Hispanic branch. Like Hispanic it changes L. *ū* into *u* and L. *au* into *o*, cf., L. *mūrum*, Cat. *mur*, Hisp. *muro* (Prov. Fr. *mur*); L. *aurum*, Cat. and Hisp. *oro* (Prov. *aur*, Fr. *or*). Unknown to Catalan, however, are the characteristically Hispanic diphthongizations of open *e* and open *o* in position, cf., L. *terra*, Hisp. *tierra*, but Cat. *terra*; L. *fortem*, Hisp. *fuerte*, but Cat. *fort* (as in Prov. and Fr.). Moreover Catalan and Provençal both change proparoxytones into paroxytones, whereas in Hispanic the proparoxytones are preserved, e.g., L. *anima*, Cat. and Prov. *alma*, *arma*.

Catalan is nowadays spoken in the major part of the department of the Pyrénées Orientales, in Andorra, at Alghero (Sardinia) whither it was brought by the Aragonese in the second quarter of the 14th century but where it is steadily succumbing to the disruptive influence of Italian and Sardinian; in the provinces of Huesca, Saragossa, Ternel; in the greater part of the provinces of Castellon de la Plana and Alicante; in much of the province of Valencia; and in the Balearic islands and Pithyusae, conquered by Jaime I. of Aragon (1229-34). The territory occupied by Catalan contains in Spain 4,486,000 inhabitants, in France some 200,000.

Catalan embraces two groups, viz., (A) continental, subdivided into (a) oriental, (b) occidental, (c) Valencian, (d) Roussillonais; (B) insular, subdivided into (a) dialects of the Balearic islands and Pithyusae, (b) dialect of Alghero. All these idioms present only minor phonetic differences. In the Balearic islands *es, sa* constitute the definite article (as also in the sub-dialect of oriental Catalan termed for this reason, *salat*) instead of *el, la*.

The outstanding difference between the Catalan of Spain and that of Roussillon, is that whereas the former is a real language with a flourishing literature, the latter is a mere patois.

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**CATALANI, ANGELICA** (1780-1849), Italian opera-singer, was born at Sinigaglia, and was the lucky possessor of one of the most remarkable soprano voices, of extraordinary compass and purity, ever known. For nearly thirty years she sang at all the great opera houses, receiving very large fees; her first appearance in London having been at the King's theatre in 1806. She remained in England, a prima donna without a serious rival, for seven years. Then she was given the management of the opera in Paris, but this resulted in financial failure, owing to the incapacity and extravagance of her husband, Captain Valabrègue—author of the historic remark "*ma femme et quatre ou cinq poupées voila tout ce qu'il faut*"—whom she had married in 1806. But her continental tours continued to be enormously successful until she retired in 1828. She died of cholera in Paris.

**CATALEPSY**, a term applied to a nervous affection characterized by sudden suspension of sensation and volition, and rigidity of the whole or of certain muscles of the body. The subjects are mostly females of highly nervous temperament. The exciting cause of an attack is usually mental emotion, either sudden, e.g. a fright, or gradual, e.g. prolonged depression. The symptoms vary even in the same individual in different attacks. Sometimes there is complete insensibility, together with a statue-like appearance of the body which retains any attitude it may be made to assume during the continuance of the attack. In this condition the whole organic and vital functions appear to be reduced to the lowest possible limit consistent with life, and may simulate actual death. At other times excitement accompanies the cataleptic symptoms, and the patient sings or utters passionate exclamations, while quite unconscious. The attack may be short or may last for many hours, or even for several days; and it is conceivable that in such cases the appearances might be mistaken for real death, as is alleged to have occasionally happened. Although catalepsy is said to occur in persons in perfect health, careful inquiry will usually reveal some abnormality; in women, menstrual derangement is generally found to have preceded the affection. It is sometimes associated with epilepsy

and with grave forms of mental disease. In ordinary cases, however, the mental phenomena closely resemble those of hysteria. In many subjects of catalepsy there is weakness of the will, whereby the tendency to lapse into the cataleptic state is not resisted but encouraged, and attacks may thus be induced by trivial circumstances (see HYPNOTISM).

**CATALINA ISLAND:** see SANTA CATALINA.

**CATALOGUE**, a list or enumeration, generally in alphabetical order, of persons, things, etc., and particularly of the contents of a museum or library. A *catalogue raisonné* is such a list classified according to subjects or on some other basis, with short explanations and notes. (See also BIBLIOGRAPHY; LIBRARIES.)

**CATALOGUES AND PRICE LISTS.** The preparation and distribution of catalogues and price lists has become an industry of enormous dimensions, the cost of printing and publishing amounting to millions of pounds per annum in Britain alone, while the expenditure of this sort in America is probably not less than sixty million dollars per annum. It is increasingly recognized that an attractive catalogue, distributed in the right way, is one of the best aids to salesmanship. The cost of production of fifty or a hundred thousand catalogues of moderate size amounts to a serious item in business expenditure. In not a few cases this leads to a cutting down of expense upon the preparation of the catalogue and this is undoubtedly the chief weakness in the preparation of commercial price lists. Another reason for the failure of many expensive catalogues is that the publisher forgets that, although he may be successful in manufacturing a certain article, it does not necessarily follow that he is successful in describing it for catalogue purposes. It is very important, therefore, that efficient literary aid should be called in by the business man to make his catalogues lucid. Thus, also, with any necessary pictures. Often the printing blocks in an expensive production have little artistic merit, and do not do full justice to the products. If we suppose ten thousand pounds to be spent upon a catalogue issue, the value of the expenditure may easily be doubled or trebled by spending an additional two hundred pounds upon the editorial work.

It is not difficult for the business man to forget in preparing a catalogue that those he wishes to read it are not as familiar with his productions as he is himself. Simplicity and lucidity of description are essential, and in this connection care should be taken to avoid the listing of a complexity of types. The excellent work done by the Washington Department of Commerce in reducing the number of types of products in various trades is directed to what is really the same point. Variety, of course, there should be, but the types chosen for listing should be distinctly different, and the reasons for the differences very clearly stated.

If, for example, the catalogue offers a series of gas heaters and cookers, the types chosen should not only be essentially different, but the essential differences should be made quite clear to the reader. If the stove is a heating appliance, the kind of room for which it is suited, the kind of flue needed, the method of installation, and the cost of maintenance should all be demonstrated. When prices vary in a series, the reason for the differences should appear. Nothing is more confusing or stultifying in a catalogue than to be told on one page that Type A of a certain manufacture is the "best," or the "finest," when the very next page refers to another thing of the same sort priced at a much higher figure. What should be done is to show clearly that the article priced is good value at its price; good value for its particular purpose; good value to meet a particular need.

**The Listing of "Extras."**—Every endeavour should be made in drawing up a catalogue to offer each article ready for use, at a price covering the entire equipment necessary to put it into use. Thus, at one time it was the unfortunate practice of motor-car manufacturers to offer their machines at a certain price, and then to add a long list of extras necessary to fit out the machine ready for the road. This practice has, happily, been abandoned in the automobile industry, but it still obtains in many other trades. First, the buyer is offered the article at a certain price, but this price does not represent the thing ready for use or consumption; a number of extras are listed in a confusing way so that the real



price of the article fit for use has to be worked out with more or less difficulty. The manufacturer of a machine-tool gains when he offers his product completely fitted with necessary safety-appliances; equally the manufacturer of a roofing felt is likely to increase his sales if his price list shows the material put into convenient rolls well packed, accompanied with the necessary amount of cement for the lapping of edges, and with purpose-made nails to fix it. The aim of every catalogue should be to offer the articles it lists ready for use.

The format of a catalogue is of great importance. The catalogue of a store should be divided into sections and well indexed. In the case of the small catalogue, or "folder," it is far better to concentrate upon one really good production at a time than to issue a sheaf of documents of different sizes which are only too likely to bewilder and irritate the would-be buyer. It is quite usual at trade exhibitions to be handed half a dozen differently shaped folders referring to a single object, instead of being given one handy, pocket-sized, beautifully printed, well-considered piece of printing.

An excellent aid to business in a catalogue, and one that is much appreciated by buyers, is the insertion of intelligent matter directly or indirectly relating to the articles offered. This may be illustrated by the case of a sports catalogue. The manufacturer of cricket-bats or tennis-rackets does well to include in his catalogue expert directions for the preservation of the articles sold, or hints on the laws of the game, or other interesting cognate matter. Again, the catalogue of a piano-player may well be accompanied by a lucid account of the invention, instructions for the care of the instrument, hints as to getting the best results from it, and so forth.

As to catalogues for the export market, it is an old complaint, and a just one, that their publishers too often fail to adapt them to the needs of the country to which they are supposed to appeal. If a catalogue is prepared for South America, for example, it is quite useless to prepare it in English; it should be translated into Spanish (or into Portuguese, if for Brazil) and weights and measures and prices expressed in their proper equivalents. Consular reports from foreign countries again and again dwell upon the neglect of these elementary measures for making an export catalogue useful.

**CATALONIA** (*Cataluña*), an autonomous region, and formerly a province of Spain, formerly also a principality of Aragon; bounded on the north by the Pyrenees, west by Aragon, south by Valencia, and east by the Mediterranean Sea. Population (1950) 3,240,313; area, 12,414 sq. miles. The triangular territory of Catalonia forms the north-east corner of the Iberian Peninsula. It was divided in 1833 into four provinces, Barcelona, Gerona, Lérida and Tarragona (*see* separate articles). The surface is much broken by southern spurs of the Pyrenees. Running south-west to north-east, and united on the north with one of the offsets of the Pyrenees, is the range of the Sierra Llena, which bisects Catalonia, and forms its central watershed. The principal rivers are the Ter, the Llobregat and the Ebro (*q.v.*), which all run into the Mediterranean. The coast is in places difficult but has important harbours, *e.g.*, Barcelona and Tarragona. Cut off orographically on the south and west Catalonia has had more associations with south France than with the Douro or Guadalquivir basins, and the Catalan language differs considerably from Castilian Spanish and has affinities with Provençal. Catalonia was one of the first of the Roman possessions in Spain, forming the north-eastern portion of Hispania Tarraconensis. About 470 it was occupied by Alans and Goths. It was conquered by the Moors in 712, but these invaders were in turn dispossessed by the Spaniards and the troops of Charlemagne in 788. Catalonia was subsequently ruled by French counts, who soon made themselves independent of France. By the marriage of Count Raymond Berenger IV. of Barcelona with Petronilla of Aragon, Catalonia became annexed to Aragón but this union was frequently severed. In 1640, when Philip IV. attempted to deprive Catalonia of its rights and privileges, it gave itself up to Louis XIII. of France. It was restored to Spain in 1659, and was once more occupied by the French from 1694 to 1697. Under Philip V. Catalonia, in 1714, was deprived

of its cortes and liberties. From 1808 to 1813 it was held by France. It was the scene of civil war in 1823, and of revolutionary operations in the Carlist wars. It supported the Loyalist cause in 1936-39. *See* also SPAIN and BARCELONA.

The average yearly temperature varies from 48° to 75°; the rainfall is about 21 in. with a maximum in the early fall months and a lower maximum in the spring. The dwarf-palm, orange, lime and olive grow in the warmer tracts; and on the higher grounds the thorn-apple, pomegranate, myrtle, esparto and heaths flourish. There is much woodland, but meadows and pastures are rare. Wheat, maize, millet, rye, flax, liquorice, vines and fruits of all sorts—especially nuts, almonds, oranges, figs and walnuts and chestnuts—are produced. Few cattle, but numbers of sheep, goats and swine are reared. Coastal fisheries are excellent. The wines are for the most part rough and strong, though good when matured. Catalonia was prominent in the wool industry early in the Middle Ages, and in modern times the extended use of water-power for textile manufacture made Barcelona an important industrial and commercial city. With the increase of irrigation the country around the city was developed as a wheat growing area.

**CATALPA**, a genus of trees belonging to the family Bignoniaceae and containing about 10 species in North America, the West Indies and China. The best known is the common catalpa (*C. bignonioides*), native to the southeastern United States, but often cultivated in parks and gardens, both in Europe and America. It is a stately tree with large, heart-shaped, pointed leaves and panicles of white, bell-shaped flowers streaked with yellow and brown-purple. The hardy catalpa (*C. speciosa*), with larger flowers, found in woods from Indiana to Missouri southward to Tennessee and Arkansas, has become naturalized elsewhere through cultivation, especially south of its native range.

**CATALYSIS**. Classically, the word catalysis means dissolution, destruction or ruin. J. J. Berzelius retained this meaning when, in 1836, he first applied the term to chemical reactions. He used it to describe the chemical decomposition of a substance hastened by a second substance (a catalyst) which did not enter into the composition of the product formed. With use, the original meaning of catalysis was lost. The term was applied to synthesis (constructive) as well as decomposition (destructive) reactions which are accelerated by a substance (the catalyst) not permanently changed in the process. Since the catalyst is not permanently changed, it may be used over and over again. A small amount of catalyst can thus effect the conversion of a large amount of the substance being changed. It is this property of catalysts which makes them so useful.

Catalysts may be gases, liquids and solids. They exert their catalytic effects on gases, liquids and solids to produce gases, liquids and solids. Although a few catalysts had been predicted for certain reactions, the science in mid-20th century had not progressed to the point where it was possible to predict generally a catalyst for a desired reaction. Catalysts for one reaction are often worthless for other reactions. Thus, catalysis bears some of the aspects of an art rather than a science in spite of the many facts known about catalysts and catalytic reactions.

#### PRACTICAL APPLICATIONS

Catalysis is of great social as well as technical and scientific importance. The average man rarely comes directly in contact with industrial catalysts and, therefore, does not realize what they do for him and how they affect the course of his life or even his death. The part played by catalysts in the production of fixed nitrogen (*see* NITROGEN, FIXATION OF) is a good example of such effects.

Fixed nitrogen is one of the essential ingredients of plant food and explosives. It is used in the form of ammonia (*q.v.*) or its derivatives, or as nitrates (*see* NITRIC ACID). Up until about 1915, fixed nitrogen was obtained from Chilean saltpetre, from a few saltpetre mines, from animal wastes and as a by-product of the coking of coal. At about this time, Fritz Haber and his co-workers produced synthetic ammonia by heating nitrogen and hydrogen, under high pressure, with a solid catalyst. Many different catalysts have been used. The early ones were osmium and ruthenium.

nium. These were expensive, and so cheaper catalysts were sought and found. Commercial plants employing this process have been installed in every industrial nation in the world.

Another catalytic reaction serves to complement the above reaction. Fixed nitrogen is needed in the form of nitrates as well as in the form of ammonia. Platinum catalysts were developed which catalyze the reaction between ammonia and the oxygen of the air, to form nitrogen dioxide which with water produces nitric acid. The over-all result is a high yield of nitric acid from the catalytic oxidation of ammonia.

These two catalytic reactions have made every nation independent, or potentially independent, of Chilean nitrate or other natural nitrate deposits. The result has been a decline in the price of fixed nitrogen, an increase in consumption and healthier plants for the farmer with better and more economical food for the average man.

These two catalytic reactions also have their sinister aspects, for, until the advent of the atomic bomb, fixed nitrogen was the backbone of both explosives (*q.v.*) and propellents. Thus, much of the destruction of World War I and World War II can be associated with these catalytic reactions, for the wars would have been quite different if both sides had had to depend on Chilean nitrates for their explosives.

**Motor Fuels.**—Aside from its application in the fixation of nitrogen, catalysis has other important social implications. A large part, if not most, of the aviation gasoline used by all nations taking part in World War II was made with the aid of catalysts. In the United States, the catalysts were used primarily for the conversion of petroleum (*q.v.*) into hydrocarbons of good antiknock quality. (1) Petroleum oils were catalytically cracked by means of synthetic silica-alumina or acid-treated clay (montmorillonite) catalysts. This process produced the "base" for the aviation gasoline, and it was responsible for a major part of the aviation gasoline produced. (2) Branched-chain paraffin hydrocarbons were synthesized by the so-called alkylation process, using sulphuric or hydrofluoric acid catalysts. Usually, isobutane and mixed butylenes were the raw materials for the process. These were produced by the catalytic as well as the thermal cracking of petroleum. The branched-chain paraffinic product was blended with the "base" from catalytic cracking. (3) Catalytic isomerization of paraffins was used to convert n-butane into isobutane and n-pentane into isopentane. Anhydrous aluminum chloride provided the essential catalytic material for all the commercial paraffin-isomerization processes. (4) Isopropylbenzene was produced from benzene and propylene by means of phosphoric acid catalysts. The isopropylbenzene was added to the gasoline to give extra power under take-off or combat conditions where fuel economy was not a consideration. The British catalytically produced *tert.*-butylbenzene from benzene and isobutylene and used it for similar purposes. (5) Propylene and butylene (*see* OLEFINE) were catalytically polymerized with the use of phosphoric and sulphuric acid catalysts (*see* POLYMERIZATION). The product was a mixture of branched-chain octenes. These were catalytically hydrogenated, with nickel or molybdenum catalysts to produce branched-chain octanes (*see* PARAFFIN HYDROCARBONS, CHEMISTRY OF) which were used in the same way alkylate was used. (6) Straight-run gasoline was converted to material suitable for use as aviation "base" by the hydroforming process. The major use of this process during World War II, however, was to produce synthetic toluene for manufacture of T.N.T. During the postwar period, vastly superior processes of this general type came into wide use for manufacture of motor gasoline and of synthetic benzene, toluene and xylenes.

The Germans, the Japanese and, to a certain extent, the British used catalytic processes to produce aviation fuels from coal. Two major processes were used. (1) A part of the coal was converted by means of heat, steam and catalysts into hydrogen. The hydrogen was caused to react catalytically with more of the coal at high pressures (*see* HYDROGENATION; PRESSURE CHEMISTRY) to produce liquid hydrocarbons which were used directly or further processed. (2) By means of heat, steam and catalysts, the coal was converted into a mixture of carbon monoxide and hydrogen. These were used in the Fischer-Tropsch process, with catalysts

containing nickel or cobalt, to produce synthetic hydrocarbons. Since these hydrocarbons were mostly of the straight-chain variety, they had poor antiknock properties and required further treatment to make good aviation fuel. These Fischer-Tropsch processes also produced diesel fuels of excellent quality, waxes and raw materials for synthetic fats and soaps.

**Other Applications.**—Catalysts also play their subtle but essential role in the production of synthetic rubber. Most of the synthetic rubber produced in the United States has been made from butadiene (*q.v.*) and styrene which are produced with the use of the proper catalysts.

Sulphuric acid (*q.v.*), itself a catalyst for many reactions, is produced in huge quantities with the aid of vanadium oxide catalysts which serve in the oxidation of sulphur dioxide to sulphur trioxide.

Vanadium oxides, usually in combination with silver, are also used in the oxidation of naphthalene by air to phthalic anhydride (*q.v.*). The public sees phthalic anhydride only after it has been transformed by the chemist into synthetic resins (*q.v.*) or into synthetic dyestuffs (*see* DYES, SYNTHETIC).

Methyl alcohol is produced from carbon monoxide and hydrogen. Zinc oxide-chromium oxide combinations are catalysts for this process. By the addition of potassium carbonate to the catalyst, n-propyl, isobutyl and higher alcohols are also produced. By means of a copper catalyst, methyl alcohol is converted into formaldehyde. Formaldehyde reaches the public as such or after it has been converted into synthetic resins, such as the phenol-formaldehyde and urea-formaldehyde plastics.

Even our food has felt the influence of catalysts. A considerable portion of the solid fats used for shortening or for making margarine have been produced by the catalytic hydrogenation of oils with nickel as the catalyst. The catalyst is removed completely before the product is marketed. (*See* OILS, FATS AND WAXES.)

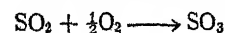
## BIOCATALYSIS

Some of the most selective catalysts known, namely the enzymes (*q.v.*) occur in nature. Each enzyme usually has a single function and will not act as a catalyst in any other way. In digestive processes, for example, a number of catalytic reactions utilize this selective action of enzymes to convert food into the forms needed for use by the body.

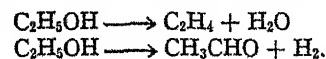
It is entirely possible that some if not all of the vitamins (*q.v.*) and hormones (*q.v.*) are catalysts. They have the selective action that characterizes catalysts and, in most cases, a very small amount of substance can produce large effects.

## FUNCTIONS OF CATALYSTS

A catalyst can increase the rate of a reaction but it cannot change the position of the final equilibrium reached in a true equilibrium reaction. In a simple reaction such as



the catalyst merely hastens the reaction toward equilibrium. Reactions involving organic compounds may be more complicated in that several reactions are possible. Some catalysts are selective in that they can hasten one of the possible reactions toward equilibrium leaving the other possible reactions practically unaffected. For example, two common reactions of ethyl alcohol are:



The first one is catalyzed by gamma alumina, the second by copper, each to the practical exclusion of the other. In the absence of catalysts both reactions occur simultaneously but at a higher temperature than the catalytic reactions. It is the ability of catalysts to accelerate selectively one of several possible reactions which made catalysis so important in industrial organic chemistry.

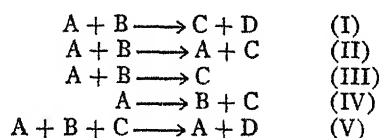
## THEORY

Catalysis may be divided into two broad branches depending on relations between the catalyst and the materials involved in the catalytic reaction. The branches are homogeneous catalysis and

heterogeneous catalysis. In homogeneous catalysis there are no phase boundaries between the substances taking part in the reaction and the catalyst. Thus all reactions which involve only gases and which are catalyzed by a gaseous catalyst are homogeneous. The same is true for reactions involving mutually soluble liquids or dissolved solids when the catalyst is soluble in the mixture.

In heterogeneous catalysis there is a phase boundary between the catalyst and the substances reacting. The most common heterogeneous reactions are those involving solid catalysts with liquid or gaseous reactants.

**Homogeneous Catalysis.**—Suppose that a chemical reaction is occurring in the gaseous state, uninfluenced by the walls of the vessel. Suppose that an observer could follow the movement of all the individual atoms. He would notice persistent groupings of atoms (molecules) which move at velocities of the order of 1,000 m.p.h., colliding frequently with other molecules and emerging from the collision substantially unchanged. He would also notice that there are occasional collisions from which new molecules emerge, and perhaps that molecules occasionally fall apart in the absence of collisions. These events are called elementary reactions. (See REACTION KINETICS.) Types of elementary reactions include

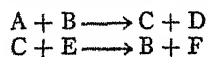


It seemed reasonably certain in the 1950s that reactions of all these types actually occurred. Depending upon the reaction under study, the observer might note that only a single elementary reaction was occurring, or a number of different elementary reactions.

Such direct and detailed observations, of course, cannot be made. The objectives of reaction-rate theory, however, are to determine from the observable data what elementary reactions actually occur and what their rates are, and to interpret these rates in terms of interatomic forces and atomic dynamics.

Of the above elementary reactions, Types II and V are inherently catalytic reactions, since A emerges unchanged. Type V corresponds to the combination of free atoms, or simple radicals such as OH. In such cases, conservation of energy and momentum make it impossible for combination to occur without a third body to remove some of the energy. There is little specificity in the effectiveness of various third bodies, and Type V is a trivial and uninteresting example of catalysis. Likewise in the case of Type II, the examples known at mid-century were few and unimportant.

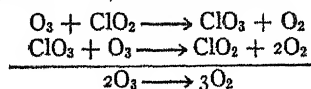
The noncatalytic reactions of Types I, III and IV may combine in many ways to produce a total reaction that represents catalysis. A simple illustration utilizing Type I reactions is



giving as the ultimate result



catalyzed by B (or C). A specific example is



where the chlorine oxides are catalysts. In any complex mechanism of this character, it is more or less a matter of accident that the catalyst is regenerated. For this reason, there is little basis for distinguishing the theory of homogeneous gas phase catalysis from that of homogeneous gaseous reactions generally.

In solution, acids and bases are powerful catalysts for a wide variety of organic reactions. This special branch of the subject, in fact, has absorbed a predominant part of all the modern scientific work on homogeneous catalysis. The original concept of acid and base catalysis was that the effective catalysts were the hydrogen and hydroxyl ions. There are a number of important reac-

tions, such as the hydrolysis of esters and the inversion of sucrose where the data available at mid-century were explicable on this basis. In general, however, it is necessary to invoke the modern definition of an acid (see ACIDS AND BASES) as a substance tending to lose a proton, and a base as one tending to gain a proton, and to recognize that all acids and bases may have catalytic activity.

The velocities of acid-base catalyzed reactions are strongly affected by the presence of neutral salts. It is customary to distinguish primary and secondary salt effects. The secondary salt effect occurs only in catalysis by weak electrolytes, and is caused by increased dissociation of the weak electrolyte caused by the presence of the neutral salt. This effect is purely thermodynamic in origin, and for sufficiently dilute solutions may be quantitatively predicted by the Debye-Hückel theory.

The primary salt effect, on the other hand, occurs with all acid-base catalysts of whatever strength. It is specific to the reaction, the catalyst and the added salt. The primary salt effect is usually positive (increase in reaction rate due to salt) but for basic catalysts is sometimes negative. The explanation current at mid-20th century for the primary salt effect is based on J. N. Brønsted's equation

$$k = k_0 \frac{f_A f_B}{f_X}$$

for the reaction rate constant  $k$  for the reaction



where  $f_A$ ,  $f_B$  and  $f_X$  are the activity coefficients for A, B, and X, the assumed "critical complex" or intermediate compound, and  $k_0$  is a constant. If this equation be granted, the calculation of primary salt effects then becomes a thermodynamic problem. Since definite information as to the critical complex, X, is limited to knowledge of its charge, this thermodynamic problem can be treated only approximately. The results, however, are consistent with experimental data on the primary salt effect.

The general picture of acid-base catalysis, from the standpoint of physical chemistry, is that the catalyst converts the reactant molecule to an ion by proton exchange, and that the ion then reacts. The interest of the organic chemist in the same phenomenon is largely that of interpreting the nature of the subsequent reactions. It is impossible to discuss the details here but it may be mentioned that reactions subject to acid-base catalysis include esterification, bromination, isomerization, molecular rearrangements, dehydration, alkylation and polymerization.

**Heterogeneous Catalysis.**—The best established examples of heterogeneous catalysis involve solid catalysts and liquid or gaseous reactants. It is almost universally true that massive materials have little or no catalytic activity, and that active catalysts are highly porous, and have total surface areas of 50-500 sq.mi./g. (5-50 ac./lb.).

There have been various theories with regard to the general nature of heterogeneous catalysis. In mid-20th century, however, there were few dissenters from the view that it involves a sequence of reactions in which the catalyst surface participates as an actual chemical reactant. The question whether the entire surface participates, or only a relatively few "active centres" such as edge or corner atoms in crystals, was in dispute.

Study of the adsorption of gases on catalyst surfaces reveals two types of adsorption (*q.v.*). The first type of adsorption is called physical or van der Waals' adsorption, since it is believed to be caused by intermolecular forces which do not disturb the existing valence bonds. The second type is called activated adsorption or chemisorption, since it is believed to represent the creation of new valence bonds. With few exceptions, heterogeneous catalysis depends on activated adsorption.

The rate of every heterogeneous reaction, therefore, depends in principle upon rates of adsorption, reaction and desorption. By reaction kinetic treatment of particular mechanisms it is possible to reproduce the major features of experimental rate data, namely that the reaction order is usually low and that retardation not only by the products but by some of the reactants is frequent. The quantitative value of such kinetic treatments is impaired by the practical necessity of using oversimplified models.

**Negative Catalysis.**—This term has been frequently, and rather loosely, applied to factors which decrease the rate of a reaction. On thermodynamic grounds a negative catalyst cannot produce an independently occurring reverse reaction. By definition, a negative catalyst cannot affect the reaction rate constant of any true elementary reaction. The only thing a negative catalyst can do, therefore, is to introduce additional elementary reactions, which may result in a lowered over-all reaction rate. This may be done either by stopping a reaction chain, or by destroying a catalyst. The latter effect is usually referred to as poisoning. Poisoning may be either permanent or temporary. From the practical standpoint, poisoning is usually objectionable, although there are a few cases in which selective poisoning is put to practical use. Substances which retard reactions by breaking chains are frequently called inhibitors. They are of major importance in preventing deterioration of gasoline, lubricants, rubber, fats, oils and other important commercial products. (See ANTIOXIDANTS.)

#### TECHNIQUE OF CATALYSIS

An outstanding feature of catalysis is the fact that chemical composition alone does not provide an adequate description of a catalyst. It has been seen that a large surface area is generally essential. It is common practice to use an inert material of large surface area as a "support" or "carrier." The active catalyst may be deposited on the support by chemical means. Commonly used supports include activated carbon, diatomaceous earth, pumice, silica gel and alumina. The use of supports is advantageous in some cases because a costly catalyst material such as platinum or silver is used more economically, and in other cases because greater stability is conferred on the catalyst.

Whether supports are used or not, the details of catalyst preparation exert major effects on the properties of the finished catalyst. Some of these effects may be correlated with such properties as crystal structure, crystal size, surface area and residual impurities, but many of them are as yet unexplained.

In many cases a catalyst can be improved by the addition of minor amounts of an additional component, which is not a catalyst by itself. Such a substance is called a "promoter." Sometimes a second promoter will still further enhance catalytic activity. In other cases a mixture of two catalytic materials will be more active than either alone; this effect is called "synergism." In still other cases a catalyst may be composed of two materials neither of which is active alone. Thus a catalyst composed of two materials may be a true two-component catalyst or a supported catalyst, or it may involve promotion or synergism.

It is possible to summarize only a few of the heterogeneous catalysts which have proved useful. For hydrogenations catalysts involving metallic nickel, iron, cobalt, platinum, palladium or copper, the oxides of copper, zinc or chromium, and the sulphides of molybdenum are common. For dehydrogenations the catalysts may involve: copper, platinum or palladium as metals, aluminum, magnesium, zinc, chromium and molybdenum as oxygen compounds, and nickel, molybdenum and tungsten as sulphur compounds. For oxidations the catalysts may involve: platinum and silver as metals, and vanadium, silver, copper and chromium as oxygen compounds. For dehydrations gamma alumina is by far the most largely used catalyst. Finally there is a group of apparently dissimilar "acid-acting" catalysts for Friedel-Crafts reactions and other reactions which involve carbonium ions. This group includes anhydrous aluminum chloride and bromide, boron fluoride, concentrated sulphuric and phosphoric acids, anhydrous hydrogen fluoride, and the silica-alumina type of catalyst used for catalytic cracking.

All known heterogeneous catalysts deteriorate with use. A common and perhaps universal cause of deterioration is loss of surface area by recrystallization. In some cases there is also an actual change in crystal type, such as from gamma alumina to alpha alumina. In addition, most catalysts are subject to "poisoning." Poisons are classed as temporary and permanent. Temporary poisons are adsorbed relatively weakly at reaction conditions, and these effects disappear more or less rapidly when the poisons are no longer present in the stream flowing to the catalyst. Permanent poisons are more strongly adsorbed, and their effects are not merely transient. Sulphur is a particularly common permanent poison for many metallic catalysts. An important "permanent" poison in some hydrocarbon reactions is a carbonaceous material of high molecular weight and of relatively low hydrogen content, which is formed as a minor reaction product. This material is produced in many high-temperature reactions, such as catalytic cracking and dehydrogenation. It is common industrial practice to

"regenerate" the catalyst periodically by burning this "coke" under suitably controlled conditions. (C. L. T., L. S. KL.)

**CATAMARAN:** see SHIP.

**CATAMARCA**, an Andean province of the Argentine republic, lying between 26° and 30° S. latitude and 65° and 69° 30' W. longitude. It is bounded on the north by the province of Salta, east by the provinces of Tucumán and Santiago del Estero, south by the provinces of Córdoba and La Rioja and west by Chile, from which it is separated by the cordillera of the Andes. The area of Catamarca is approximately 45,829 sq. mi. Population (1947) 147,213. The chief city of the province is Catamarca (pop. [1947] 31,067), the capital, situated on a fertile tableland in the southeastern part of the province. Other important cities are Andalgalá, Tinogasta and Belén.

The region is in general mountainous, with many high peaks perpetually covered by snow. Between the numerous longitudinal ranges of mountains are tablelands and valleys, some of the latter being exceedingly fertile while others are completely barren and covered by sand. The climate varies with altitude but is for the most part warm and dry, the rainfall ranging from 8 to 15 in. in the west to 24 in. in the east. Water is one of the major problems in the province, and its scarcity greatly retarded the development of agriculture and grazing. The principal crops sown are alfalfa, maize and wheat. The principal minerals of the province that are exploited are wolfram, copper, mica, antimony, clay, asbestos and tin. Of these, and in direct response to markets created by World War II, wolfram and mica came to rank first in economic importance. Another industry that characterizes the region, carried on largely by women, is the hand weaving of fine ponchos and cloth from wool and vicuña. Olives are grown extensively.

Two railways, the former Central Córdoba and the Central Norte Argentino, merged in the national railway system, serve the southeastern part of the province. The latter line provides direct communication between the capital of the province and the federal capital, a distance of 895 mi. Highways are mostly in the eastern half of the province. (R. W. Rd.; C. E. Mc.)

**CATAMARCA** (*San Fernando de Catamarca*), capital of province of same name on Río del Valle de Catamarca, Argentina, 230 mi. (318 mi. by rail) N.N.W. of Córdoba. Pop. (1947 census) 31,067. The city stands in a narrow, picturesque valley at the foot of the Sierra de Ambato, 1,772 ft. above sea level. The valley is highly fertile, partially wooded, and produces fruit in abundance, wine and some cereals. In the city are flour mills and tanneries, and among its exports are leather, fruit, wine, flour and a curious embroidery for which the women of Catamarca have long been famous. There are several fine churches, which have been declared national monuments. The alameda is one of the most attractive in the Argentine republic, having a reservoir of 2 ac. surrounded by shrubbery and walks. Catamarca was founded in 1683 by Fernando de Mendoza because the town of Chacra, the former provincial capital had been found unhealthy. Previous to the selection of Chacra as the provincial capital, the seat of government was at San Juan de la Rivera de Londres, founded in 1558 and named after the capital of England by order of Philip II in honour of his marriage with Queen Mary. Catamara is one of the communities of the republic which most conserves the traditional spirit of the colonial and postindependence eras. (C. E. Mc.)

**CATANIA**, a city and episcopal see of Sicily, the chief town of the province of Catania, on the east coast, 59 mi. S. of Messina by rail and 151 mi. S.E. of Palermo by rail (102 mi. direct). Pop. (1951) 297,531 (commune). The cathedral of S. Agatha, with relics of the saint, retains its three original Norman apses (1091), but is otherwise baroque and there are other good baroque churches and palaces. In the west the huge Benedictine abbey of S. Nicola (now suppressed) occupies about 21 ac. and contains the museum, a library, observatory, etc. This was the highest point of the ancient city, which lay almost entirely to the west of the modern Via Stesicorea Etuca, which runs for 3,000 yd. in a straight line toward the summit of Mt. Etna. The university, founded in 1444, has regained some of its former importance. To the south near the harbour is the massive Ca el



'Ursino, erected in 1232 by Frederick II. The Roman theatre (no Greek theatre has been found) has been superimposed upon the Greek building, some foundations of which, in calcareous stone, of which the seats are also made, still exist. It is 106 yd. in diameter, and is estimated to have accommodated 7,000 spectators. Close to it are the remains of the so-called Odeum, of similar plan to the theatre but without a stage, and to the north is the church of S. Maria Rotonda, originally a Roman domed structure, perhaps part of a bath. To the north, in the Piazza Stesicoro, is the amphitheatre, a considerable portion of which has been uncovered, including a part of the arcades of the exterior already excavated. The external diameters of the amphitheatre are 410 and 348 ft., while the corresponding diameters of the arena are 233 and 167 ft. It is thus the third largest Roman amphitheatre known, being surpassed only by that at Verona and the Colosseum. Remains of many other Roman buildings also exist beneath the modern town, among the best preserved of which may be noted the public baths (*Thermae Achilleae*) under the cathedral, and those under the church of S. Maria dell' Indirizzo. The number of baths is remarkable, and gives some idea of the luxury of the place in Roman times. The majority were excavated by Prince Ignazio Biscari (1719-86). Some monumental Roman tombs have also been found, and it is only from their position that we can infer the boundaries of the Roman city, for no remains of its walls exist.

Catania exports sulphur, pumice stone, asphalt, oranges and lemons, almonds, filberts, cereals, wine and oil. The harbour is a good one. There is an old harbour with an area of .03 sq. mi. and a new harbour of .16 sq. mi.; the combined length of quays is 2 mi. Sulphide of carbon is produced here, and there are large dyeworks.

The ancient Catina (Gr. *Katane*, Rom. *Catina*<sup>1</sup>) was founded in 729 B.C. by colonists from Naxos, perhaps on the site of an earlier Sicel settlement—the name is entirely un-Greek, and may be derived from *κάτινον*, which in the Sicel language, as *catinum* in Latin, meant a basin, and would thus describe the situation. Charondas, a citizen of Catina, is famous as its lawgiver, but his date and birthplace are alike uncertain; the fragments preserved of his laws show that they belong to a somewhat primitive period. The poet Stesichorus of Himera died here. Very little is heard of Catina in history until 476 B.C., when Hiero I. removed its inhabitants to Leontini, repopled it with 5,000 Syracusans and 5,000 Peloponnesians, and changed its name to Aetna. In 461 B.C., however, with the help of Ducetius and the Syracusans, the former inhabitants recovered possession of their city and revived the old name. Catina was, however, an ally of Athens during the Syracusan expedition (415-413 B.C.), and served as the Athenian base of operations in the early part of the war. In 403 B.C. it was taken by Dionysius of Syracuse, who plundered the city, sold the inhabitants into slavery and replaced them with Campanian mercenaries. In the First Punic War it was one of the first cities of Sicily to be taken by the Romans (263 B.C.). In 123 B.C. there was an eruption of Etna so violent that the tithe on the territory of Catina payable to Rome was remitted for ten years. It appears to have flourished in the first century B.C., but to have suffered from the ravages of Sextus Pompeius. It became a Roman colony under Augustus, and it is from this period that the fertile plain, hitherto called the plain of Leontini, begins to be called the plain of Catina. It seems to have been at this time the most important city in the island, to judge from the language of Strabo and the number of inscriptions found there. In A.D. 251 a lava stream threatened the town and entered the amphitheatre, which in the time of Theodoric had fallen into ruins, as is clear from the fact that he permitted the use of its fallen stones for new buildings. It was occupied by Belisarius in 546, sacked by the Saracens in 902 and taken by the Normans. The latter founded the cathedral; but the town was almost entirely destroyed by earthquake in 1170, and devastated by Henry VI. in 1197. It became the usual residence of the Aragonese viceroys of the 13th and 14th centuries, and one of them, De Vega, reconstructed the fortifications in 1552. In 1669 an eruption of Etna partly filled up the harbour,

but spared the town, which was, however, almost entirely destroyed by the earthquake of 1693. During World War II Catania was heavily bombed by Allied planes. Near Catania the Germans put up a stiff resistance against the British in the summer of 1943.

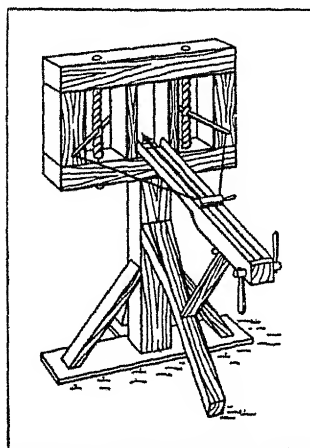
See A. Holm, *Catania Antica* (trans. G. Libertini) (Catania, 1925); F. de Roberto, *Catania* (Bergamo, Arti Grafiche, 1907).

**CATANZARO**, a town and episcopal see of Calabria, Italy, capital of the province of Catanzaro, 1,125 ft. above sea-level. Pop. (1936) 27,907 (town); 45,400 (commune). The station for the town (Catanzaro Sala) is on a branch connecting the two main lines along the east and west coasts of Calabria, 6 mi. N. by W. of Catanzaro Marina on the east coast, and 20 mi. E. of S. Eufemia Biforcazione, on the west coast line. The town enjoys a comparatively cool climate in summer, and commands fine views. Numerous wealthy families reside here. The town was bombed by the Allies in World War II.

**CATAPHYLL**, a botanical term denoting any rudimentary scalelike leaf which precedes the foliage leaves, as a bud scale, etc.

**CATAPULT**, a generic name for warlike engines of the cross-bow type used by the ancients (Lat. *catapulta*, Gr. *καταπέλτης*). (See ENGINES OF WAR.) They are usually classed as (a) catapults and (b) ballistae (*λιθοβόλοι*). The former were smaller and were used with arrows for what is now called direct fire (i.e., at low angles of elevation); the latter were large siege engines discharging heavy bolts or stones at a high angle of elevation, like the modern howitzer.

The essential parts of the catapult (see illustration) were the frame, the propelling gear, the trough (corresponding to the modern barrel) and the pedestal. The frame consisted of two horizontal beams forming top and bottom sills, and four strong upright bars mortised into them. The three open spaces or compartments resembling narrow windows, between these four uprights, carried the propelling and laying gear. The propelling gear occupied the two outer "windows." In each a thick skein of cord or sinews was fastened to the top and bottom sills and tightly twisted. The stiff wooden arms were inserted in the two skeins, and a specially strong bowstring joined the tips of these arms. In the middle compartment was the hinged fore-end of the trough, which was at right angles to the frame and at the back of it. The trough



CATAPULT USED IN ANCIENT SIEGE WARFARE

This engine, capable of discharging a 26 in. arrow weighing ½ lb., had an effective range of 400 yards

could be laid for elevation by a movable prop, the upper end of which was hinged to the trough, while the lower ran up and down a sort of trail fastened to the pedestal. The whole equipment was laid for "line" by turning the frame, and with it the trough, prop and trail by a pivot in the head of the pedestal. Sliding up and down in the trough was a block, fitted with a trigger mechanism, through which passed the middle of the bowstring. The pedestal was a strong and solid upright resting upon, and strutted to, a framework on the ground; its upper end, as mentioned above, took the pivot of the frame and the head of the trail. On coming into action the machine was laid for direction and elevation. The block and with it the bowstring was next forced back against the resistance of the twisted skeins to the rear end of the trough, this being effected by a windlass attachment. The trigger being then pressed or struck with a hammer, the bowstring was released from the block, the stiff arms were violently brought back to the frame by the untwisting of the skeins, and the arrow was propelled through the centre "window" with great velocity. A small machine of the type described weighed about 85 lb., and sent a "three-span" (26 in.) arrow weighing ½ lb. at an effective man-killing velocity somewhat over 400 yds.

<sup>1</sup>This is the form vouched for by the inscriptions.

The ballista was considerably larger and more expensive than this. In Scipio's siege train, at the attack of New Carthage (Liv. xxvi. 47, 5), the number of the ballistae was only one-sixth that of the catapults. In the ballista the rear end of the trough (which projected in front of the frame) always rested upon the ground, or rather was fixed to the framework of the pedestal—which was a heavy trestle construction—and the trough was thus restricted to the angle of elevation, giving the maximum range (45°). Even so, the range was not appreciably greater than that of a catapult, and in the case of the largest ballistae (90-pounder) it was much less. These enormous engines, which, once in position, could not be laid on any fresh target, were used for propelling beams and stones rather than for shooting arrows, that is, more for the destruction of material than for man-killing effect. The skeins that supplied the motive force of all these engines were made of the sinews of animals, twisted raw hide, horsehair rope, and, in at least one celebrated case, of women's hair. In 146 B.C., the authorities of Carthage, having surrendered their engines to the Romans in the vain hope of staying their advance, new ones were hurriedly constructed, and the women and virgins of the city cut off their hair to supply the needed skeins.

The modern implement known as a "catapult" is formed by a forked stick, to the forks of which are attached the ends of a piece of elastic. To the middle of this elastic a pocket is fitted to contain a bullet or small stone. In use the forked stick is held in the left hand and the pocket drawn back with the right. Aim is taken and, the pocket being released, the missile flies through the fork of the stick. Though classed as a toy, this weapon can do considerable execution among birds, etc., when skilfully used. The name of "catapult" has also been given to a bowling machine which is used for cricket practice.

**CATARACT**, a waterfall (Gr. *καταράκτης*, a floodgate, or waterfall, something which rushes down). The earliest use in English is of a floodgate or portcullis, and this survives in the name of a disease of the eye (see EYE, DISEASES OF; OPHTHALMOLOGY). The term is also used of a device to regulate the strokes in certain types of steam-engine.

**CATARGIU** (or CATARGI), **LASCAR** (1823–1899), Rumanian statesman, belonged to an ancient Walachian family, one of whose members had been banished in the 17th century by Prince Matthew Bassaraba and had settled in Moldavia. Under Prince Gregory Ghica (1849–56) Catargiu rose to be prefect of police at Jassy. In 1857 he became a member of the *Divan ad hoc* of Moldavia, a commission elected in accordance with the treaty of Paris (1856) to vote on the proposed union of Moldavia and Walachia. His strongly conservative views, especially on agrarian reform, induced the Conservatives to support him as a candidate for the throne in 1859. During the reign of Prince Cuza (1859–66) Catargiu was one of the Opposition leaders. On the accession of Prince Charles in May 1866 Lascar Catargiu became president of the council (prime minister); but finding himself unable to co-operate with his Liberal colleagues, I. C. Bratianu and C. A. Rosetti, he resigned in July. After eight more ministerial changes, culminating in the anti-dynastic agitation of 1870–71, Catargiu formed, for the first time in Rumanian history, a stable Conservative cabinet, which lasted until 1876. Impeachment of himself and his cabinet was threatened, but the proposal was withdrawn in 1878, and he remained in opposition until 1889, when he formed a short-lived cabinet, taking the portfolio of the Interior. In the Florescu ministry of March 1891 he occupied the same position, and in Dec. he again became president of the council, retaining office until 1895. He died at Bucharest on April 11, 1899.

**CATARRH**, a term chiefly signifying mild inflammation of the mucous membrane of the respiratory passages, in popular language a "cold." It is the result of infection by a micro-organism, especially *M. catarrhalis*, which may occasionally be a causative factor. Its pathogenic significance is slight.

The term catarrh is used in a wider sense to describe a similar pathological condition of any mucous surface in the body; e.g., gastric catarrh, intestinal catarrh, etc. (See also ALIMENTARY SYSTEM, DISEASES OF THE; RESPIRATORY SYSTEM, DISEASES OF.)

**CATARRHINE MONKEY**, the term used (in contradistinction to Platyrrhine, *q.v.*) to describe those apes which have the nostrils approximated; the aperture pointing downward; and the intervening septum narrow. These are the distinguishing features of all the old world primates. (See PRIMATES.)

**CATASTROPHE**, in ancient Greek drama the change in the plot which leads up to the conclusion (Gr. *καταστροφή*, to overturn). Hence any sudden change, particularly of a disastrous nature, and, in earlier geological theories, a great convulsion of the earth's surface.

**CATAWBA**, the principal tribe of the eastern division of the Siouan stock of American Indians. The name is probably derived from the Choctaw *katāpa*, meaning "divided" or "separated."

Formerly the dominant people of South Carolina, the Catawba also had divisions extending into North Carolina. In the 17th century the population was about 5,000, but by 1780 it had declined to about 500. By the beginning of the 20th century there were only about 60 members of the tribe.

The Catawba, who were at war with the Iroquois for a long time, furnished a valuable contingent to the South Carolina troops during the American Revolution. They retreated to Virginia upon the advance of British troops in 1870, but they later returned and occupied small towns on the Catawba river. They afterward leased their land and about 1841 sold all of it except one square mile to the state. At that time a number of them went to the territory of the Cherokee in western North Carolina, but they did not remain long with their former enemies and soon returned to South Carolina. A vocabulary of about 300 words, collected by Oscar M. Lieber, the geologist, in 1856, was published in *Collections of the South Carolina Historical Society*, vol. ii (1858).

See F. W. Hodge (ed.), *Handbook of the American Indians* (1912).

**CATAWBA**, an amber coloured, richly flavoured wine made from the light-red grape of the same name. The grape is a variety of the *Vitis labrusca*, a North American and Asiatic species, and takes its name from the Catawba river in North and South Carolina. In 1807 the grape was grown in Washington, D.C., but it was not until about 1823 that the name Catawba was given to it. It spread rapidly in New York, Ohio and Ontario and was extensively grown in the Finger lake section of New York. The vine is extremely prolific, the fruit being large and very sweet. The grapes are readily preserved, and their great use is partly accounted for by that fact. The wine is largely used as a base for champagne.

**CATBALOGAN**, a municipality (with administrative centre and 16 barrios or districts) and capital of the province and island of Samar, Philippine Islands. Pop. (1948) 26,839. It lies midway between the ports of Manila and Zamboanga and is a port of call for coastwise and other craft. Abacá (Manila hemp) is produced in the country tributary to the town and there are manufactures of woven fibres and mats which are also made from *tiking* (sedge). Most of these are exported. The fisheries are important. The vernacular is Samarino, a dialect of Bisayan. Of those inhabitants 6 to 19 inclusive, 21.6% attended school in 1939, and of those ten years old and over 37% were literate.

**CATBIRD** (*Dumetella carolinensis*), a North American bird of the thrasher family Mimidae, about 9 in. long, a summer visitor from the Gulf of Mexico, north to New Brunswick and Hudson Bay. Its plumage is slate-gray, with a black cap and tail and chestnut under tail coverts. It is noted for its beautiful song, with much of the charm of its close relative, the mocking-bird. The name expresses the mewing protest of the bird when angry. The catbird winters in the southern states, in Cuba and from Mexico to Panama. It is resident in Bermuda. In Australia, a name, given to any one of several bowerbirds (*q.v.*), especially to *Ailu-roedus crassirostris*, which builds no bower. The name comes from a catlike mewing.

**CATBOAT**, a small sailing-boat of the pleasure variety, having the mast stepped forward and carrying a single fore-and-aft mainsail set on a boom and gaff, known as a *cat rig*. They are also known as Una boats, and frequently carry a centre-board (*q.v.*).

**CATCH**, a form of concerted vocal music virtually indistinguishable from the round, save for the fact that it is always



humorous in character. The catch had its greatest vogue in earlier centuries, when also the words to which it was sung were too often more jocose than refined. Particulars of various collections available occupy a column of small print in *Grove*. Of the innumerable catch and glee clubs which existed in England in former days one, known simply as the Catch Club, founded as long ago as 1761, still exists. (See also under CANON; CONTRA-PUNTAL FORMS; GLEE; RONDEL.)

**CATCH-CROPS** are rapidly growing crops that occupy the soil for short periods of time to absorb or "catch" nitrates that might otherwise be carried away in drainage waters. They are usually grown between the times of two principal crops or between the rows of another crop. Rye, oats and vetch are frequently used, but other crops and plants, including weeds, may serve as well. When the immature plants are plowed under, the nitrogen absorbed is returned to the soil where it can again be used to nourish other plants. Many gardeners and farmers have found that they can improve their production efficiency by giving attention to the use of catch-crops in their cropping systems.

In practice, however, the term catch-crops is often used with other meanings. Some regard them as quickly maturing crops grown between two principal crops for the purpose of keeping the land completely utilized. Defined in this way, catch-crops may occupy idle land for longer periods of time and include more species of plants than under the more restricted definition given above. The crops serving as catch-crops will be useful, not only for conserving nitrates, but also for soil protection, soil enrichment and as additional sources of feed for livestock.

Special crops planted between two principal crops for the purpose of protecting the soil against water and wind erosion are frequently called cover-crops. They may also function as catch-crops and as sources of organic matter for soil enrichment.

Crops planted between two principal crops, chiefly for the purpose of soil enrichment, are more accurately described as green manure crops. Legumes, because of their ability to obtain nitrogen from the atmosphere, are used more frequently for this purpose than non-legume crops. In the North American corn-belt, for instance, biennial sweet clover, a deep rooted legume, is widely used as a green manure crop. It is seeded in early spring in either fall- or spring-seeded grains and plowed under the following spring for corn. If conditions are favourable, as much as 100 lb. or more of atmospheric nitrogen and several tons of organic matter rich in nutrient minerals may be added to an acre of land. In addition to these benefits, the sweet clover or other green manure crops may also serve as catch and cover crops.

In view of the overlapping functions of catch, cover and green manure crops, it is difficult to use these classifications accurately. Some call all special crops planted between two principal crops catch-crops, while others use the designations that best express the major purposes for which the crops are grown. (F. C. BR.)

**CATCHMENT AREAS.** The term "catchment area" is used to describe the collecting area from which water would flow to a stream or river, the boundary of the area being determined by the ridge separating water flowing in opposite directions. The amount of water collected within the catchment area would depend on the extent of that area, the amount of rain which has fallen on the surface, and the proportion of that rainfall which has been lost by evaporation or absorption. The term "run-off" has been adopted to describe that portion of the rainfall which ultimately finds its way to the stream, and the ratio between the rainfall and the "run-off" varies widely, according to the climatic conditions. In England and Scotland the average annual rainfall varies from a little over 20 in. to 175 in., and the annual loss by evaporation from a land surface varies from about 10 to 18 in., being less in the north, increasing towards the south.

**Evaporation.**—The loss by evaporation depends on the hours of sunshine, the temperature, and the humidity of the atmosphere, and varies greatly during the different periods of the year as might naturally be expected. The following average figures for the period 1883–1900 illustrate the effect of these various factors on the proportion of the rainfall which flowed over Teddington weir from the Thames catchment area above that point.

	Average hours of sunshine.	Average tempera- ture.	Average humidity.	Proportion of rainfall flowing over Teddington weir.
		Degrees.	Degrees.	Per cent.
Jan.–March	57.5	39.6	84.5	60.9
April–June	163.2	53	74.3	30
July–Sept.	159.8	60.2	75.7	12
Oct.–Dec.	46.1	41	86.5	28

The total annual loss by evaporation in Britain is less in regions of high rainfall than in areas of low rainfall, and the seasonal loss varies in a similar manner. The influence of climatic conditions on the evaporation is so marked, that in tropical countries the proportion of the rain which flows off the ground is small.

It has been held that forests tend to increase the discharge of a river by reducing evaporation, but such evidence as has been obtainable fails to support this view. Shade cast by the trees would reduce evaporation, but rain which would otherwise flow from the ground, is absorbed by the trees. Although forests have but little effect on the annual loss by evaporation, their presence has an influence in delaying the flow of water from the hillsides, and when a catchment area has been cleared of timber, floods tend to become more intense.

Evaporation from a water surface is greater than from a land surface, especially in tropical countries, and is a matter of importance when lakes occupy a considerable proportion of the catchment area.

**Absorption.**—The amount of rain falling on the surface which percolates downwards depends on the porosity of the surface soil and the nature of the underlying rock, whether impermeable, porous, or fissured.

When the surface is impermeable, there would be no loss by percolation.

When the surface is permeable but is underlain by impermeable rock, water percolates downwards till that rock is reached and then travels underground in the direction of the steepest inclination of the rock surface, which is generally towards the stream, water lost by percolation reappearing as springs. Such percolation has little influence on the annual run-off, but may have a marked effect on its variations throughout the year. Thick beds of permeable material, such as sand or gravel, absorb large volumes of water, acting as natural storage reservoirs. During periods of abundant rainfall the beds would become saturated, and during periods of dry weather water so absorbed would be gradually discharged, thus maintaining a considerable flow in the stream.

This point is of great importance when it is desired to utilize the water of a stream without constructing a storage reservoir to balance its fluctuations, as the quantity of water which could be taken during certain periods would be limited to the dry weather flow.

When the surface is permeable and is underlain with permeable or fissured rock, such as chalk, the entire rainfall on the catchment area might percolate downwards, reappearing in the form of springs issuing either within or without the limits of the catchment area.

In the former case there would be no surface flow above the point where the springs break out, and in the latter, the whole catchment area would be void of streams. (W. J. E. B.)

**CATECHISM**, a compendium of instruction (particularly of religious instruction) arranged in the form of questions and answers. The custom of catechizing was followed in the schools of Judaism and in the Early Church, where it helped to preserve the Gospel narrative. (See CATECHUMEN.)

The catechism as we know it is intended primarily for children and uneducated persons. Its aim is to instruct, and it differs from a creed or confession in not being in the first instance an act of worship or a public profession of belief. The first regular catechisms seem to have grown out of the usual oral teaching of catechumens, and to have been compiled in the 8th and 9th cen-

tures. They continued on through the Middle Ages to the 16th century. The original of all modern catechisms, because of its question and answer form, is the *Disputatio Puerorum Per Interrogationes Et Responsiones* (*Patr. Lat.*, CI, 1097-1144), of the 9th century. In the 12th century the *Elucidarium* of Honorius of Autun (*Patr. Lat.*, CLXXII, 1110-1176) and the *De Quinque Septenariis* of Hugh of St. Victor (*Patr. Lat.*, CLXXV, 405-414) were well known and had much influence on subsequent catechisms. Jean Gerson (1363-1429), chancellor of the University of Paris, took great interest in catechizing, taught children both at Paris and Lyons, and wrote among other catechetical works his *ABC des simples gens*. The first catechism printed in Germany was the *Christenspiegel* of Coelde, which first appeared in 1470, proved very popular and was in its 5th edition by 1514. But though catechisms had already been in use, the 16th century saw a tremendous increase in their number and importance, as ever-increasing facilities for printing were available and the age of the Reformation began. Both the new Protestant Churches and the Catholic Church strove zealously to instruct their members and to win new adherents.

In 1520 Luther had brought out a primer of religion dealing briefly with the Decalogue, the Creed and the Lord's Prayer; and other leaders had done something of the same kind. In 1529 all these efforts were superseded by Luther's Smaller Catechism meant for the people themselves and especially for children, and by his Larger Catechism intended for clergy and schoolmasters. These works did much to mould the character of the German people and powerfully influenced other compilations.

In 1537 John Calvin at Geneva published his catechism for children. It was called *Instruction and Confession of Faith for the use of the Church of Geneva* and explained the Decalogue, the Apostles' Creed, the Lord's Prayer and the Sacraments. It was the work of a man who knew little of the child mind, and, though it served as an admirable and transparent epitome of his famous *Institutes*, it was too long and too minute for the instruction of children. Calvin came to see this, and in 1542 drafted a new one which was much more suitable for teaching purposes. This was used in Geneva and in Scotland. The Reformed churches of the Palatinate, on the other hand, used the Heidelberg Catechism (1562-63), mainly the work of two of Calvin's disciples, Kaspar Olevianus and Zacharias Ursinus. This work is perhaps the most widely accepted symbol of the Calvinistic faith, and is noteworthy for its emphasis on the less controversial aspects of the Genevan theology. As revised by the synod of Dort in 1619, it became the standard of most of the Reformed churches of central Europe, and in time of the Dutch and German Reformed Churches of America.

Since 1648 the standard Presbyterian catechisms have been those compiled by the Westminster assembly, presented to parliament in 1647, and then authorized by the General Assembly of the Church of Scotland (July 1648) and by the Scottish parliament (Jan. 1649). The Larger Catechism is "for such as have made some proficiency in the knowledge of the Christian religion," but is too detailed and minute for memorizing, and has never received anything like the reception accorded to the Shorter Catechism, which is "for such as are of weaker capacity." The work was done by a committee presided over first by Herbert Palmer, master of Queens', Cambridge, and then by Anthony Tuckney, master of Emmanuel. The Shorter Catechism, after a brief introduction on the end, rule and essence of religion, is divided into two parts: I. The doctrines we are to believe (1) concerning the nature of God, (2) concerning the decrees of God and their execution. II. The duties we are to perform (1) in regard to the moral law, (2) in regard to the gospel—(a) inward duties, i.e., faith and repentance, (b) outward duties as to the Word, the sacraments and prayer. It has 107 questions and answers, while that of the Anglican Church has but 24, grouping as it does the ten commandments and also the petitions of the Lord's Prayer, instead of dealing with them singly.

Though the Catholic Church had long been using catechisms, they were multiplied with new emphasis as the Church swung

into the Counter Reformation. The most famous was that of the Jesuit Peter Canisius, first published in 1555. It went through 400 editions within 150 years. Another catechism which had a large circulation and greatly influenced later works was that of Bellarmine (1597); in France those of Auger (1563) and Bossuet (1687) were outstanding. The *Catechism of the Council of Trent*, completed in 1566, was never intended as an ordinary catechism. It was written for and addressed to parish priests, to serve as model and guide in their instructions and sermons to the people. The Catholic Church, because its unity of doctrine is otherwise so safeguarded, has never adopted any one official catechism for all its members. Each bishop is free to adapt his method of instruction to local conditions. Many bishops themselves, however, have desired a universal catechism; at the Vatican council (1870) the project was seriously discussed, with Bellarmine's catechism proposed as model. In more recent times well known catechisms have been the *Baltimore Catechism* (1885) in the United States, the *Penny Catechism* in England, and that of Deharbe (1847) in Germany. In the present century, pedagogical-catechetical congresses and periodicals (e.g., *Journal of Religious Instruction*, Joseph F. Wagner, N.Y.) have stimulated new methods, which methods in turn have produced new catechisms and aids. The classic survey of this period is *Où En Est L'Enseignement Religieux?* (Louvain, 1937), which lists and appraises the books and methods of the different countries.

Peter Mogilas, in 1643, composed the *Orthodox Confession of the Catholic and Apostolic Eastern Church*. This counteraction to the activities of the Jesuits and the Reformed Church was standardized by the synod of Jerusalem in 1672. A smaller catechism was drawn up by order of Peter the Great in 1723. The catechisms of Levshin Platon (1762) and V. D. Philaret (1839), each in his day metropolitan of Moscow, are bulky compilations which cannot be memorized, though there is a short introductory catechism, prefaced to Philaret's volume (Eng. trans. in Blackmore's *Doctrine of the Russian Church*, 1845).

The catechism of the Church of England is included in the Book of Common Prayer. It has two parts: (i) the baptismal covenant, the Creed, the Decalogue and the Lord's Prayer drawn up probably by Cranmer and Ridley in the time of Edward VI, and variously modified between then (1549) and 1661; (ii) the meaning of the two sacraments, written on the suggestion of James I at the Hampton Court conference in 1604 by John Overall, then dean of St. Paul's. This supplement to what had become known as the Shorter Catechism established its use as against the longer one, *King Edward VIth's Catechisme* which had been drawn up in 1553 by John Ponet, bishop of Winchester, and enlarged in 1570 by Alexander Nowell, Overall's predecessor as dean of St. Paul's. By the rubric of the Prayer Book and by the 59th canon of 1603, the clergy are enjoined to teach the catechism in church on Sundays and holidays after the second lesson at Evening Prayer. This custom, long fallen into disuse, has largely been revived during recent years, the children going to church for a special afternoon service of which catechizing is the chief feature. Compared with the thoroughness of most other catechisms this one seems scanty, but it has a better chance of being memorized, and its very simplicity has given it a firm hold on the inner life and conscience of devout members of the Anglican communion throughout the world.

Almost every Christian denomination has its catechism or catechisms. Besides those already enumerated there are two interesting joint productions. In 1898 the National Council of the Evangelical Free Churches in England and Wales published an *Evangelical Free Church Catechism*, representing directly or indirectly the beliefs of 60 or 70 millions of avowed Christians in all parts of the world, a striking example of inter-denominational unity. The *School Catechism* was issued in 1907 by a conference of members of the Reformed churches in Scotland, which met on the invitation of the Church of Scotland. In its compilation representatives of the Episcopal Church in Scotland co-operated, and the book, though "not designed to supersede the distinctive catechisms officially recognized by the several churches for the instruction of their own children," certainly "commends itself as

suitable for use in schools where children of various churches are taught together."

During the 19th century in the United States the Sunday school was recognized by various Protestant denominations as the primary instrument for religious instruction. By the middle of the century the Bible was regarded as primary curriculum material, the catechism secondary, though still important.

See the *Encyclopaedia of Religion and Ethics*, s.v. (A. J. G.; X)

**CATECHOL**, PYROCATECHIN or PYROCATECHOL, orthodihydroxybenzene, crystallizes in white rhombic prisms, which melt at 104° C. and boil at 245° C.; it is readily soluble in water, alcohol and ether. Catechol,  $C_6H_4(OH)_2$ , was first prepared in 1839 by H. Reinsch in distilling catechin (the juice of *Mimosa catechu*); it occurs free in kino and in beechwood tar; its sulphonic acid is present in the urine of man and the horse. It is formed in the alkaline fusion of many resins, and may be prepared by heating *o*-chlorophenol with aqueous alkali to 150° C.–200° C. in the presence of a catalyst, by treating salicylaldehyde with hydrogen peroxide, or by heating its methyl ether, guaiacol,  $C_6H_4(OH)(OCH_3)$ , a constituent of beechwood tar, with either concentrated hydrobromic acid or aluminum chloride.

Ferric chloride gives a green coloration with aqueous catechol, while its alkaline solution rapidly changes to a green and finally to a black colour on exposure to the air. It reduces ammoniacal silver solutions in the cold with formation of a silver mirror and alkaline cupric salts to cuprous oxide on heating.

Guaiacol may be obtained directly from beechwood tar, from catechol by methylation with potash and potassium methyl sulphate at 180° C., or from anisole by nitration and subsequent reduction to aminoanisole, which is then diazotized and boiled with water. It melts at 28° C. and boils at 205° C. It is employed in medicine as an expectorant. The dimethyl ether or veratrol is also used in medicine.

Many other catechol derivatives have been suggested for therapeutic application. Guaiacol carbonate is known as duotal, the phosphate as phosphatol, the phosphite as guaiaco-phosphal; phosphotal is a mixture of the phosphites of creosote phenols. The valeric ester of guaiacol is known as geosote, the benzoic as benzosol, the salicylic as guaiacol salol, while the glycerin ether appears as guaiamar.

Catechol is the starting point in the synthesis of the active principle of the suprarenal capsules which is variously known as adrenaline, epinephrine and supranaline. The successive stages in this synthesis are catechol, chloroacetocatechol, methylaminoacetocatechol (adrenalone) and inactive adrenaline, which is resolved into physiologically active *l*-adrenaline through the bitartrate.

**CATECHU** or CUTCH, an extract obtained from several plants (the derivation is from the Malay *Kachu*), its chief sources being the wood of two species of acacia (*A. catechu* and *A. suma*), both natives of India.

This extract is known as black catechu. A similar extract, known in pharmacy as pale catechu (*Catechu pallidum*), and in general commerce as gambir, or *terra japonica*, is produced from the leaves of *Uncaria gambir* and *U. acida*, cinchonaceous plants growing in the East Indian archipelago. A third product to which the name catechu is also applied is obtained from the fruits of the areca or betel palm, *Areca catechu*.

Ordinary black catechu is usually imported in three different forms. The first and best quality, known as Pegu catechu, is obtained in blocks externally covered with large leaves; the second and less pure variety is in masses, which have been moulded in sand; and the third consists of large cubes packed in coarse bags. The wood of the two species of *Acacia* yielding catechu is taken for the manufacture when the trees have attained a diameter of about one foot.

The bark is stripped off and used for tanning and the trunk is split up into small fragments which are covered with water and boiled. When the extract has become sufficiently thick it is cast into the forms in which the catechu is found in commerce.

Catechu so prepared is a dark brown or, in mass, almost black substance, brittle, and having generally a shining lustre. It is

astringent, with a sweetish taste. In cold water it disintegrates, and in boiling water, alcohol, acetic acid and strong caustic alkali it is completely dissolved. Chemically it consists of a mixture of a peculiar variety of tannin termed catechutannic acid with catechin or catechuic acid, and a brown substance due to the alteration of both these principles.

Catechutannic acid is an amorphous body soluble in cold water, while catechin occurs in minute, white, silky, needle-shaped crystals which do not dissolve in cold water. A very minute proportion of quercetin, a principle yielded by quercitron bark, has been obtained from catechu.

**Gambir**.—Gambir, which is similar in chemical composition to ordinary catechu, occurs in commerce in the form of cubes of about an inch in size with a pale brown or yellow colour and an even earthy fracture. For the preparation of this extract the plants above mentioned are stripped of their leaves and young twigs and these are boiled down in shallow pans. The juice is strained off, evaporated, and when sufficiently concentrated is cast into shallow boxes, where, as it hardens and dries, it is cut into small cubes.

Gambir and catechu are extensively employed in dyeing and tanning. For dyeing they have been in use in India from the most remote period, but it was only during the 19th century that they were placed on the list of European dyeing substances. Catechu is fixed by oxidation of the colouring principle, catechin, on the cloth after dyeing or printing; and treated thus it yields a variety of durable tints of drabs, browns and olives with different mordants (see DYEING). The principal consumption of catechu occurs in the preparation of fibrous substances exposed to water, such as fishing lines and nets, and for colouring stout canvas used for covering boxes and portmanteaus under the name of tanned canvas.

Gambir is used medicinally as an astringent, especially in the treatment of diarrhoea. It is no longer included in the United States *Pharmacopoeia*. In Great Britain, pale catechu is the official term.

**CATECHUMEN**, a technical term applied to a person receiving instruction in the Christian religion with a view to baptism (Gr. *κατηχούμενος*, one receiving instruction, from *τηχεῖν*, to teach orally). The catechumenate grew naturally out of Judaism, which as a missionary religion had to instruct recruits. These were admitted by circumcision and baptism, women by baptism only. Second-century practice in Palestine is described in *Yebamot* 47 a.b., "They acquaint him with some of the lighter and some of the weightier commandments. . . . As they show him the penalty of breaking commandments, so they show him the reward of keeping them. . . . If he accepts, they circumcise him forthwith . . . when he is healed they at once baptize him." The ordeal was clearly much lighter for women. For this and other reasons there was a considerable body of potential proselytes on the fringe of Judaism. They were known as "God-fearers"; if they shrank from circumcision themselves they generally had the rite performed on their sons (G. F. Moore, *Judaism*, i, 323 ff.).

The Apostles are said to have instructed converts after baptism (Acts ii, 41–42); the earliest teaching was presumably an explanation of the Messianic prophecies in the Old Testament. On the gentile mission Paul's strongest appeal was made to the "God-fearers," who had been already won for monotheism and Jewish standards of morality, and for whom circumcision was no longer necessary. The word *κατηχεῖν* applied to Christian instruction, presumably both before and after baptism, occurs in the New Testament in Luke i, 4 (of Theophilus), Acts xviii, 25 (of Apollos)—the exact meaning is disputed; see *APOLLOS* and Gal. vi, 6 ("let him that is taught communicate with him that teacheth in all good things").

As the gentile element in the church preponderated, instruction became more definite. It was probably undertaken by the "teachers" (1 Cor. xii, 28). *The Teaching of the Twelve Apostles*, i–vi, is a manual of ethical teaching. The *Shepherd of Hermas* was widely used (Eas. H. E. III. iii, 6.). Justin Martyr (*Apol.* i, 61) says converts are taught to pray for forgiveness before baptism.

In the 4th century, with the rise of heresy, detailed doctrinal teaching was given. Of those treatises which have survived, the most important are Cyril of Jerusalem's *Catechetical Lectures*, Gregory of Nyssa's *Catechetical Oration*, and Augustine's *de Rudibus Catechizandis*. By this time the postponement of baptism had become general; thus Constantine was not baptized till he was at the point of death. Accordingly a large proportion of Christians belonged to the catechumenate. Most of them were merely "adherents" of the Church; others were under definite instruction for baptism. The preparation, preceded probably by a period of probation, generally coincided with the 40 days of Lent, the baptism taking place on Easter Eve. The preparation consisted of (a) instruction in what must be renounced, (b) instruction in the faith, (c) exorcisms of evil spirits (see BAPTISM). All catechumens attended the first part of the Eucharistic Service, known in the West as *Missa Catechumenorum*, after which they were "dismissed." As infant baptism became general, the catechumenate decayed. The baptismal rites now used are clearly adaptations of rites intended for the reception of adult catechumens. In the mission field the catechumenate has been revived and primitive conditions are repeated. Thus a polygamist will often be a life-long "adherent" debarred from baptism by marriage difficulties of his own making. (W. K. L. C.)

**CATEGORICAL** means generally unconditional, not subject to any conditions or reservations. 1. *In Logic*—The term categorical is used to describe those judgments or propositions which are neither hypothetical nor disjunctive. These latter are the two types of conditional propositions (see CONDITION); categorical propositions are those which make absolute or unconditional assertions, like *S is P* or *S is not P*. But the distinction between categorical and conditional propositions is relative to the extent that it is frequently possible to express a proposition of the one type as a proposition of the other type without much violence to their meaning, e.g., the categorical assertion: *Equilateral triangles are equiangular*, can also be expressed in the conditional form: *If a triangle is equilateral it is equiangular* (hypothetical), or *either a triangle is equiangular or it is not equilateral* (disjunctive). 2. *In Ethics* Kant introduced the term "categorical imperative" for a moral law that is unconditional or absolute, or whose validity or claim does not depend on any ulterior motive or end. According to Kant there is only one such categorical imperative, which he formulates variously. One formula is: "Act only on such a maxim as you can will that it should become a universal law." This is purely formal, and expresses the condition of the rationality of conduct, rather than the condition of its morality. Another formula given by Kant is: "So act as to treat humanity, whether in your own person or in another, always as an end, and never as only a means." (See KANT, and ETHICS, HISTORY OF.)

**CATEGORICAL IMPERATIVE:** see CATEGORICAL.

**CATEGORY** means a predicate. Now the predicate of an assertion is usually some class-name or concept under which the subject is brought, in the case of affirmative assertions, or from which the subject is excluded, in the case of negative assertions. In popular usage, accordingly, the term category is applied to any class or concept. Philosophically, however, the term category is confined to *ultimate* modes of being, or to the ultimate concepts or modes of apprehension by which reality is known. The first systematic account of categories was given by Aristotle. His account held the field for many centuries. Its most serious competitor in the history of philosophy is the account given by Kant. But although the general orientation of the two philosophers was very different, yet their lists of categories are remarkably similar when due allowance is made for their difference in philosophical standpoint.

**Aristotle's Account of the Categories.**—This is contained partly in the treatise of that name which forms the first of the collection of logical treatises known as the *Organon*, and partly in the *Metaphysics*. Aristotle assumed that our ultimate modes of apprehending reality correspond to ultimate modes of being. Like most pre-Kantian philosophers who were not sceptics Aristotle did not seriously consider the possibility that reality may

not be in itself what it is perceived or conceived to be. The Aristotelian categories were accordingly regarded by him as expressing at once ultimate modes of being and ultimate modes of apprehension (or predication). His list of categories was as follows (the Latin and English equivalents are added for convenience)

οὐσία ποσόν	substantia quantitas	substance quantity	πότε κεῖσθαι	quando situs	time position (or situation)
ποιόν πρός τι	qualitas relatio	quality relation	ἔχειν ποιεῖν	habitus actio	state (or condition) activity
ποῦ	ubi	place	πάσχειν	passio	passivity (or being acted on)

How exactly Aristotle arrived at his scheme of ten categories is not known. It has been suggested that he was guided by familiar grammatical distinctions—nouns, adjectives of quantity and of quality, adverbs of place and of time, the active and the passive voice of verbs, and so on. But there is no real evidence of this contention. A certain degree of correspondence between categories and grammatical distinctions would be inevitable in any case, seeing that distinctions in thought naturally find expression in linguistic differences.

In order to understand the Aristotelian list of categories one must be clear about the meaning of "ultimate modes of being" which they were intended to express. J. S. Mill was under the impression that the list was intended to be a table of classification of all nameable things, and consequently criticized it as at once defective in some respects and redundant in others. But that was a misconception. To be a "thing" is only one "mode of being," namely, that of "substance," in the Aristotelian list. But the same concrete reality can embody many or all modes of being. Of Aristotle, for instance, one can predicate that he was a man (substance) who lived in Athens (place) in the 4th century B.C. (time), taught philosophy (activity), was accused of atheism (passivity), felt depressed (state), fled to friends (relation), and so on. A classification of "things" would be bad if it included the same object (say, Aristotle) in several classes at once. But it is quite different with "modes of being." Several or all ultimate modes of being may, and do, exist in the same concrete individual, and yet such mode of being may be quite distinct from, and irreducible to, any other. To be a "thing" is different from being a "quantity" or "quality," etc., and none of them can be made intelligible by reference to the other. The predicate "green" may be explained by reference to "colour," and "colour" may be explained by reference to "quality"; but "quality" itself cannot be usefully explained by reference to any other term, but is ultimate in this sense. Similarly with the other categories—they were all intended to express ultimate modes (or *summa genera*) of being, and therefore of predication.

Aristotle himself did not regard his ten categories as of equal importance. It is clear that he regarded substance as, in a sense, the most fundamental category, inasmuch as quantity, quality, etc., can only exist in substances. Hence the Scholastic, Cartesian and Spinozistic distinction between *Substance* and *Accidens* (or *Mode*), between that which exists by itself and that which only exists in another. Curiously enough recent thought has tended more and more to discard the category of substance altogether (see SUBSTANCE) in favour of a world of "events" in space-time. There is also a tendency to discard the categories of activity and passivity or at least to reduce them to that of quantity (see CAUSALITY).

**Kant's Account of the Categories.**—This is most intimately connected with his "critical" standpoint, and constitutes the very core of his philosophy. Kant dismisses the idea that we can have knowledge of things as they are in themselves (*noûmena*), and he confines human knowledge to phenomena, that is, to *appearances* of the real rather than to the inner *being* of it. This standpoint involves jettisoning of one side of the doctrine of the categories as taught by Aristotle, namely, the claim that they represent ultimate modes of *being*. From Kant's point of view the enquiry must confine itself to ultimate modes of human apprehension or forms of synthesis. Now Kant held that in all so-called human knowledge certain raw materials are supplied from outside, but that they are worked up, as it were, by certain forms of



apprehension which are inherent in the human mind (see A PRIORI), and he distinguished two groups of such forms of synthesis. In one group he placed space and time, which he regarded as forms of synthesis involved already in the very possibility of apprehending things at all in sense-perception. They are forms of sense-apprehension or perception (as distinguished from forms of thought). In the other group he placed the categories or forms of thought. This restriction of the term category to a mode of thought as distinguished from any other mode of apprehension is peculiar to Kant. Aristotle made no such distinction, and using the term category in the Aristotelian sense, it may be said that Kant recognized the Aristotelian categories of space and time, at least as modes of predication. In Kant's special sense, however, the categories are forms of conceptual or intellectual synthesis. Now judgment is the same as thought or understanding. The ultimately different forms of judgment should consequently express the ultimately different kinds of synthesis of the understanding. Kant accordingly derived his list of categories from the different forms of judgment. But instead of critically determining first what the ultimate forms of judgment are he took over from formal logic the usually recognized list with just a little further elaboration or over-elaboration. His result is represented in the following table which gives the Kantian categories together with the various forms of judgment to which they severally correspond. It will be observed that they are grouped into four principal classes with three divisions in each.

<i>Form of Judgment</i>	<i>Corresponding Category</i>
I. Quantity.	I. Quantity.
(a) Singular ( <i>This S is P</i> )	(a) Unity
(b) Particular ( <i>Some S's are P</i> )	(b) Plurality
(c) Universal ( <i>All S's are P</i> )	(c) Totality
II. Quality	II. Quality
(a) Affirmative ( <i>S is P</i> )	(a) Reality
(b) Negative ( <i>S is not P</i> )	(b) Negation
(c) Infinite ( <i>S is not P</i> )	(c) Limitation
III. Relation	III. Relation
(a) Categorical ( <i>S is P</i> )	(a) Substantiality
(b) Hypothetical ( <i>If A, then C</i> )	(b) Causality
(c) Disjunctive ( <i>Either A or B</i> )	(c) Reciprocity
IV. Modality	IV. Modality
(a) Problematic ( <i>S may be P</i> )	(a) Possibility and Impossibility
(b) Assertive ( <i>S is P</i> )	(b) Existence and Non-existence
(c) Apodictic ( <i>S must be P</i> )	(c) Necessity and Contingency.

It will be noticed that Kant's table of categories includes a number of the Aristotelian categories, and to these must be added space and time, which Kant did not call categories, but which he practically recognized as categories in Aristotle's sense of the term, at least on the epistemological side if not on the ontological side. But there are also obvious differences between the two schemes. The most remarkable of these is the entire absence from the Aristotelian scheme of anything corresponding to Kant's categories of modality. This difference is significant because it shows most clearly the difference in their ways of approaching the problem. Kant, as already indicated, was mainly or exclusively interested in thought, and possibility, actuality, and necessity certainly express real differences in our way of thinking about things. Aristotle, however, regarded the categories primarily as modes of being; and differences of modality do not express any differences in the being of things.

**Later Tendencies.**—The problem of the categories continued to attract deep interest after the time of Kant, and occupied a very prominent place in the thought of Hegel whose whole philosophy turned on it. English philosophers also devoted a good deal of attention to the problem, especially J. S. Mill. Gradually, however, interest was lost in the categories as a special problem, although it continued to receive some attention from historians of philosophy, and is of course dealt with incidentally in such new systems of philosophy as that of S. Alexander (*Space, Time and Deity*). The fact is that the new movements in geometry and in physics are tending to upset such familiar categories as those of space, time, substance and causality, and the whole subject may be said to be in the melting-pot.

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**CATENA, VINCEZZO DI BIAGIO** (c. 1470–1531) Venetian painter, a descendant of an old Venetian family, and not the same person as the artist Vincenzo da Treviso, with whom he was at one time erroneously identified. Catena probably studied in Giovanni Bellini's studio in Venice during the last decades of the 15th century. Ridolfi, the earliest of Catena's biographers, says of him: "The character of Catena's genius as a painter was noble, as his works show. In addition, he was the possessor of great wealth, which enabled him to paint at ease and to gain distinction. He lived at the same time as Giorgione, whose glory he strove to emulate by every means in his power." The Bellinesque phase of his art is represented by the three following pictures, which are all signed: "Virgin and Child," in the Walker gallery at Liverpool; "Virgin and Child with Saints and Donors," in the Mond Collection; "The Holy family with a saint," at Budapest. The "Trinity" in the church of S. Simeone Grande at Venice, and the "Virgin and Child with two Saints" in the Venice Academy (348) may also be ascribed to this early period. The following works may be classified as representing his second or middle period, when Giorgione's influence made itself increasingly felt; "The Doge Leonardo Loredan kneeling before the Virgin" (1510), in the Doge's Palace; the "St. Jerome in his Study," and the "Madonna and Child, with a kneeling warrior," both in the National Gallery. The latter picture was purchased as by Giorgione. "The Adoration of the Infant Christ with Donor and Shepherd boy," of Lord Brownlow's collection; "Christ giving the Keys to St. Peter" in the Gardiner collection at Boston; half figure of Judith in the Querini-Stampalia collection in Venice, and his masterpiece dated 1520, the "Glorification of St. Cristina," in S. Maria Mater Domini at Venice; these all belong to the middle and best period. The "Judith" ascribed to Giorgione in the Hermitage at Leningrad has been ascribed to Catena by two authorities (Hadeln, Richter). A representative work of Catena's last period is the "Holy Family" at Dresden (Woermann 65) which is cool in tone and pale in colour. Catena was a good portraitist; the Berlin museum contains his portrait of Raimund Fugger mentioned by Vasari; at the National Gallery, London, and the Vienna museum are two portraits in the Bellini style. Catena died soon after Sept. 30, 1531, the date of his last will. He left his property to the Painter's guild at Venice, with provision for dowries to daughters of poor painters.

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**CATENARY:** see CURVES, SPECIAL.

**CATERAN**, the band of fighting men of a Highland clan (Gaelic *ceathairne*, a collective word meaning peasantry); hence the term is applied to the Highland, and later to any, marauders or cattle-lifters.

**CATERHAM**, forms with Warlingham an urban district of Surrey, England, 20 mi. S. of London by the S.R. Pop. (1938) 27,100. Area 12.9 sq.mi. It lies in healthy Downs country, and has grown in modern times into a large residential town. Three planning schemes were adopted. Large barracks and the metropolitan district insane asylum are in the neighbourhood.

**CATERPILLAR**, the popular name given to the larva of butterflies, moths and saw-flies (see LEPIDOPTERA; HYMENOPTERA; INSECTS; METAMORPHOSIS).

**CATESBY, ROBERT** (1573–1605), English conspirator, son of Sir William Catesby of Lapworth, Warwick, prominent recusant, was born in 1573, and entered Gloucester hall (now Worcester college), Oxford, in 1586. In 1596 he was one of those arrested on suspicion during an illness of Queen Elizabeth. In 1601 he took part in the rebellion of Essex, was wounded in the fight and imprisoned, but finally pardoned on the payment of an

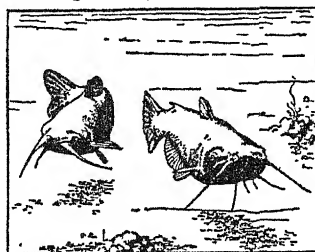
enormous fine. In 1602 he dispatched Thomas Winter and the Jesuit Tesimond *alias* Greenway to Spain to induce Philip III to organize an invasion of England, and in 1603, after James's accession, he was named as an accomplice in the "Bye plot." Exasperated by his personal misfortunes and by the repressive measures under which his co-religionists were suffering, he was now to be the chief instigator of the Gunpowder plot. The idea seems first to have entered his mind in May, 1603. About the middle of Jan. 1604 he imparted his scheme of blowing up the Parliament house to his cousin Thomas Winter, subsequently taking in Guy Fawkes and several other conspirators. But his determination not to allow warning to be given to the Roman Catholic peers was the actual cause of the failure of the plot. A fatal mistake had been made in imparting the secret to Francis Tresham, in order to secure his financial assistance; and there is little doubt that he was the author of the celebrated letter to his brother-in-law, Lord Monteagle, which betrayed the conspiracy to the government on Oct. 26. On receiving the news, Catesby exhibited extraordinary coolness; he refused to abandon the attempt, and his confidence was strengthened by Fawkes's report that nothing in the cellar had been touched or tampered with. After the discovery of the conspiracy Catesby fled with his fellow-plotters, taking refuge ultimately at Holbeche, Staffs., where on the night of Nov. 8 he was overtaken and killed. He had married Catherine, daughter of Thomas Leigh of Stoneleigh, Warwick, and left a son, Robert, who inherited that part of the family estate which had been settled on Catesby's mother and was untouched by the attainder. Robert is said to have married a daughter of Thomas Percy. (See also GUNPOWDER PLOT.)

**CAT-FISH**, the name generally given to the fishes of the sub-order Siluroidea of the order Ostariophysi, in which the air-bladder is connected with the internal ear by a chain of ossicles, probably enabling the fishes to hear well. From the Cyprinoids (characins, carps and electric eels) the Siluroids are distinguished by having the body naked or armoured with bony plates, never normally scaled, and by a number of osteological characters: the air-bladder generally extends laterally so that on each side it is in contact with the skin above the pectoral fin. The name "cat-fish" has reference to the long barbels or feelers about the mouth, of which one pair supported by the maxillaries is always present; generally there are two pairs below the chin, and frequently another developed from the valves between the nostrils. Nearly all the Siluroids are fresh water fishes, but two families are secondarily marine, the Ariidae, found on the coasts and in estuaries of all tropical countries, and the Plotosidae of the Indo-Pacific. The group is a large and varied one, containing probably about 2,000 species belonging to 23 different families; most are omnivorous, feeding on almost any kind of animal or vegetable food, and acting as scavengers. The spines of the dorsal and pectoral fins, which are so generally present, are powerful weapons, capable of inflicting severe and sometimes poisonous wounds.

The cat-fishes of North America belong to the family Amiuridae, which is peculiar to that continent, and is known from freshwater deposits in Wyoming dating from the middle Eocene age. The Amiuridae are closely related to the Bagridae of Africa and Asia, and like them and most Siluroids have a short dorsal fin, with a spine, followed by an adipose fin on the tail. The anterior rays of the pectoral fins are spinous. The head is rather flat, with the mouth terminal and moderately wide, and the jaws with bands of small teeth; there are eight barbels. There are about 25 species, some of which are small; *Amiurus lacustris* of the Great Lakes attains a weight of more than 150 lb. These fishes scoop out a nest in the mud, and the male parent guards the eggs, and later swims with the brood near the shore.

The European cat-fish, (*Silurus glanis*), the "Wels" of the Germans, is said to reach a length of 10 ft. and a weight of 400 lb. It

has a very long tail, beneath which is the long anal fin. Another species (*Parasilurus aristotelis*) occurs in Greece; the remaining Siluridae are Asiatic. In South and Central America are no less than nine families of Siluroids, all endemic. *Diplomyste* of Chile and Argentina, with toothed maxillary, is the most primitive living

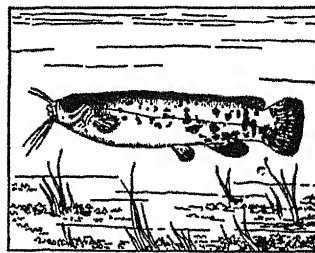


BY COURTESY OF THE NEW YORK ZOOLOGICAL SOCIETY

FIG. 2.—CAT-FISH OF THE GREAT LAKES, (*AMIURUS LACUSTRIS*)

Siluroid, but other South American forms are highly specialized. Of the Aspredinidae, *Aspredo batrachus* is remarkable for the way in which the female carries the eggs on the abdomen; these sink into the soft spongy skin and a cup develops round each and then becomes stalked. The Trichomycteridae include *Stegophilus* and *Vandellia*, little slender naked fishes that live parasitically in the gill chambers of other fishes, and are said to enter the urethra of persons bathing, and by distending the short spines with which the gill-covers are armed, to cause inflammation or even death.

The Loricariidae, with about 300 species, are mostly fishes that are covered by a long armour of five series of bony plates on each side, and have the lips expanded into a sucker by means of which they hold on to stones. They feed mainly on mud and algae and have a very long intestine that is coiled like a watch-spring. In some species there are pronounced sexual differences, the males having broader and blunter heads, margined with spines or bristles, or bearing branched tentacles on the snout. In the mountain streams of the Andes the Loricariidae are represented by small forms (*Cyclopium* or *Arges*) known as "prenadillas"; in these regions there are no carnivorous fishes to attack them and they are completely naked, having lost the bony armour that protects the lowland forms. A mining engineer who had diverted a stream in order to empty a pot-hole, observed a number of these fishes climb a precipice from the hole to the stream above it, obtaining alternate holds with the sucker and the rough surface of the pelvic fins; these were moved forward by the contraction of special muscles attached to the pelvic bones, while the sucker was holding. The Callichthyidae are another armoured family, but with only two rows of plates on each side of the body. Callichthys builds nests of grass, sometimes placed in a hole scooped out of the bank; both parents guard the nest. In the South American Doradidae, as in the similar but unrelated Mochochidae of Africa, the air-bladder is a sound-producing organ. *Doras* travels from one pond to another in the dry season, sometimes journeying all night. The Clariidae of Africa and Asia are also air-breathing fishes, provided with air-chambers above the gills; in *Clarias* special vascular tree-like organs nearly fill the chamber, but in *Saccobranchus* these are absent and the air-sac extends backwards for half the length of the fish. These are elongate, more or less eel-shaped fishes; in the dry season they burrow in the mud, but some species are said to leave their burrows at night and crawl about on land in search of food.



FROM JORDAN, "FISHES" (D. APPLETON)  
FIG. 3.—CAT-FISH OF AFRICA, (*MALOPTERURUS ELECTRICUS*)

The African Amphiliidae and the Sisoridae of India have the lower surface of the head and abdomen flat and the paired fins horizontal, an adaptation to life in mountain torrents; in some genera the lips form a sucker similar to that of the Loricariidae. The electric cat-fish (*Malopterurus electricus*) is widely distributed in Africa. The skin is soft, and immediately beneath it lies the electric organ, formed of rhomboidal cells of a fine gelatinous substance, and differing from that of other fishes in being part of the tegumentary system, not derived from the muscles. Certain species of *Synodontis*, a genus common in the Nile, are white on the back and blackish beneath, a coloration connected with their habit of swimming belly upwards. The Ariidae,



most of which live in salt water, are typical Siluroids in form and structure of the fins, whereas the other marine family, the Plotosidae, have a very long tail, with the long anal fin confluent with the caudal. In some species of *Arius* the eggs, few in number and as large as marbles, are carried about by the male in his mouth. *Bucklandium* from the lower Eocene (London clay) is an *Ariid*.

(C. T. R.)

**CATGUT**, the name applied to cord of great toughness and tenacity prepared from the intestines of sheep, or occasionally from those of the horse, mule and ass. Those of the cat are not employed, and therefore it is supposed that the word is properly *kitgut*, *kit* meaning "fiddle," and that the present form has arisen through confusion with *kit-cat*. The substance is used for the strings of harps and violins, as well as other stringed musical instruments, for hanging the weights of clocks, for bow-strings, and for suturing wounds in surgery. To prepare it the intestines are cleaned, freed from fat, and steeped for some time in water, after which their external membrane is scraped off with a blunt knife. They are then steeped for some time in an alkaline lye, smoothed and equalized by drawing out, subjected to the antiseptic action of the fumes of burning sulphur, if necessary dyed, sorted into sizes, and twisted together into cords of various numbers of strands according to their uses. The best strings for musical instruments are imported from Italy ("Roman strings"), and it is found that lean and ill-fed animals yield the toughest gut.

**CATHA**, a shrub (*Catha edulis*, family Celastraceae) native to Arabia and to Africa from Abyssinia to the Cape. It is also cultivated, especially in Arabia, where it is called *khat*, *kat*, or *kasta*.

The Arabians make a kind of tea from the dried leaves and young shoots. These are also chewed extensively for their stimulant properties, which somewhat resemble those of coca.

**CATHARS** (CATHARI or CATHARISTS), a widespread heretical sect of the middle ages. This article relates to the Western Cathars, as they appear (1) in the Cathar Ritual written in Provençal and preserved in a 13th-century ms. in Lyons, published by Clédat, Paris, 1888; (2) in Bernard Gui's *Practica inquisitionis haereticæ pravitatis*, edited by Canon C. Douais, Paris, 1886; and (3) in the *procès verbal* of the inquisitors' reports. Some are dualists, and believed that there are two gods or principles, one of good and the other of evil, both eternal; but as a rule they subordinated the evil to the good, and all were universalists in so far as they believed in the ultimate salvation of all men.

Their tenets were as follows:—The evil god, Satan, who inspired the malevolent parts of the Old Testament, is god and lord of this world, of the things that are seen and are temporal, and especially of the outward man which is decaying, of the earthen vessel, of the body of death, of the flesh which takes us captive under the law of sin and desire. This world is the only true purgatory and hell, being the antithesis of the world eternal, of the inward man renewed day by day, of Christ's kingdom which is not of this world. Men are the result of a primal war in heaven, when hosts of angels incited by Satan or Lucifer to revolt were driven out, and were imprisoned in terrestrial bodies created for them by the adversary.

How shall man escape from his prison-house of flesh, and undo the effects of his fall? For mere death brings no liberation, unless a man is become a new creation, a new Adam, as Christ was; unless he has received the gift of the spirit and become a vehicle of the Paraclete. If a man dies unreconciled to God through Christ, he must pass through another cycle of imprisonment in flesh; perhaps in a human, but with equal likelihood in an animal's body. For when after death the powers of the air throng around and persecute, the soul flees into the first lodging of clay that it finds. Christ was a life-giving spirit, and the *boni homines*, the "good men," as the Cathars called themselves, are his ambassadors. They alone have kept the spiritual baptism with fire which Christ instituted, and which has no connection with the water baptism of John; for the latter was an unregenerate soul, who failed to recognize the Christ, a Jew whose mode of baptism with water

belongs to the fleeting outward world and is opposed to the kingdom of God.

The Cathars fell into two classes, corresponding to the Baptized and the Catechumens of the early church, namely, the Perfect, who had been "consoled," i.e., had received the gift of the Paraclete; and the *credentes* or Believers. The Perfect formed the ordained priesthood and controlled the church; they received from the Believers unquestioning obedience, and as vessels of election in whom the Holy Spirit already dwelt, they were adored by the faithful, who were taught to prostrate themselves before them whenever they asked for their prayers. They alone were become adopted sons, and so able to use the Lord's Prayer, which begins, "Our Father, which art in heaven." The Perfect alone knew God and could address him in this prayer, the only one they used in their ceremonies. The mere *credens* could at best invoke the living saint, and ask him to pray for him.

All adherents of the sect seem to have kept three Lents in the year, as also to have fasted Mondays, Wednesdays and Fridays of each week; in these fasts a diet of bread and water was usual. But a *credens* under probation for initiation, which lasted at least one and often several years, fasted always. The life of a Perfect was so hard, and, thanks to the inquisitors, so fraught with danger, that most Believers deferred the rite until the death-bed, as in the early centuries many believers deferred baptism. The rule imposed complete chastity. The passages of the New Testament which seem to connive at the married relation were interpreted by the Cathars as spoken in regard of Christ and the church. The Perfect must also leave his father and mother. The family must be sacrificed to the divine kinship. He that loveth father or mother more than Christ is not worthy of him, nor he that loveth more his son or daughter. The Perfect takes up his cross and follows after Christ. He must abstain from all flesh diet except fish. He may not even eat cheese or eggs or milk, for they, like meat, are produced *per viam generationis seu coitus*. Everything that is sexually begotten is impure. Fish were supposed to be born in the water without sexual connection, and on the basis of this old physiological fallacy the Cathars framed their rule of fasting. And there was yet another reason why the Perfect should not eat animals, for a human soul might be imprisoned in its body. Nor might a Perfect or one in course of probation kill anything, for the Mosaic commandment applies to all life.

The central Cathar rite was *consolamentum*, or baptism with the spirit. The spirit received was the Paraclete, the Comforter, derived from God and sent by Christ, who said, "The Father is greater than I." Of a consubstantial Trinity the Cathars naturally had never heard. Infant baptism they rejected because it was unscriptural and because all baptism with water was an appanage of the Jewish demiurge Jehovah, and as such expressly rejected by Christ. The *consolamentum* removes original sin, undoes the effects of the primal fall, clothes upon us our habitation which is from heaven, restores to us the lost garment of immortality. A Consoled is an angel walking in the flesh, whom the thin screen of death alone separates from Christ and the beatific vision. The rite was appointed by Christ, and has been handed down from generation to generation by the *boni homines*.

In the case of a candidate for initiation the Perfect addresses the postulant by the name of Peter; and explains to him from Scripture the indwelling of the spirit in the Perfect, and his adoption as a son by God. The Lord's Prayer is then repeated by the postulant after the elder, who explains it clause by clause. Then came the Renunciation, primitive enough in form, but the postulant solemnly renounced, not Satan and his works and pomp, but the harlot church of the persecutors; he renounced the cross which its priests had signed on him by baptism and other magical rites. Next followed the spiritual baptism itself, consisting of imposition of hands, and holding the Gospel on the postulant's head. The elder begins a fresh allocution by citing Matt. xxviii. 19, Mark xvi. 15, 16, John iii. 3 (where the Cathars' text must originally have omitted in v. 5 the words "of water and," since their presence contradicts their argument). Acts ix. 17, 18, viii. 14-17, are then cited; also John xx. 22-23, Matt. xvi. 18, 19, Matt. xviii. 18-20, for the Perfect one receives in this rite power

to bind and loose. The Perfect's vocation is then defined in terms of a strictly literal observance of the Commandments and the Sermon on the Mount. Asked if he will fulfil these demands, the postulant answers: "I have this will and determination. Pray God for me that he give me his strength." The next episode of the rite exactly reproduces the Roman *confiteor* as it stood in the 2nd century; "the postulant says: '*Parcite nobis*. For all the sins I have committed, in word or thought or deed, I come for pardon to God and to the church and to you all.' And the Christians shall say: 'By God and by us and by the church may they be pardoned thee, and we pray God that he pardon you them.'"

There follows the act of "consoling." The elder takes the Gospel off the white cloth, where it has lain all through the ceremony, and places it on the postulant's head, and the other *boni homines* present place their right hands on his head, they shall say the *parcias* (spare), and thrice the "Let us adore the Father and Son and Holy Spirit," and then pray thus: "Holy Father, welcome thy servant in thy justice and send upon him thy grace and thy holy spirit." Then they repeat the "Let us adore," the Lord's Prayer, and read the Gospel (John i, 1-17). This was the vital part of the whole rite. The *credens* is now a Perfect one; the Perfect ones present give him the kiss of peace, and the rite is over.

The Cathar Eucharist was equally primitive, and is thus described by a contemporary writer in a 13th-century manuscript in the Milan library: "The Benediction of bread is thus performed by the Cathars. They all, men and women, go up to a table and standing up say the 'Our Father,' [as according to St. Gregory (*Ep. ii*, 12-26), was the custom of the apostles]. And he who is prior among them, at the close of the Lord's Prayer, shall take hold of the bread and say: 'Thanks be to the God of our Jesus Christ. May the Spirit be with us all.' And after that he breaks and distributes to all. And such bread is called bread blessed, although no one believes that out of it is made the body of Christ."

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**CATHARSIS** means purification. Since the time of Aristotle the term has been definitely associated with the question of the effects of tragedy on the spectators or on the actors. Aristotle maintained that tragedy and also certain kinds of music tend to purify the spectators and listeners by artistically exciting certain emotions which act as a kind of homeopathic relief from their own selfish passions. Goethe was of opinion that the catharsis affects the actors in the tragedy rather than the spectators or readers. Lessing, on the other hand, held that it affects the spectators and readers rather than the performers. Lessing also maintained that catharsis takes the form of a sublimation of the emotions or their conversion into virtuous dispositions.

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**CATHARTIC**, an agent used to relieve constipation. Aperients, laxatives, cathartics, eccoprotics, purgatives, physics, hydragogues and drastics, arranged in order of intensity, differ only in the degree to which they act. Cathartic action depends usually upon increased fluidity or bulk of the gut contents or upon irritation of the gut. Cathartics include: (1) saline cathartics such as sodium and magnesium sulphate, poorly absorbable salts that hold water in the gut by osmotic force; (2) bulk producers such as psyllium seeds and agar which take up water and swell, and bran which contains a high proportion of insoluble material; (3) emollients such as mineral oil which is poorly absorbed and coats the intestinal wall with an oily film, preventing the absorption of water; (4) irritant oils such as castor oil and croton oil; (5) anthracene derivatives such as senna, rhubarb, cascara and aloë which owe their activity to various polyhydroxyanthro-

quinones, present usually as glucosides, (6) the cathartic resins such as euphorbium, jalap, podophyllum, elaterium gamboge and colocynth in which the active ingredient is usually a glucosin; (7) miscellaneous irritants such as phenolphthalein and mercurous chloride (calomel).

Cathartics have been exploited by the patent-medicine industry probably more than any other group of drugs. Many cases of chronic constipation have resulted from their indiscriminate use. They should be taken only upon the advice of a physician since serious harm can result from an attempt to relieve gastrointestinal symptoms without knowing their cause.

**CATHARTIDAE:** see VULTURE.

**CATHAY**, the name by which China became known to medieval Europe. It is derived from Khitai, the name of the kingdom of Khitan Tatars (10th and 11th centuries A.D.) which, based on Manchuria (the northeastern gateway into China), included at times part of northern China as well and which toward its close had its capital at Yenking (Kublai Khan's Cambaluc, *q.v.*, and the modern Peking). The central Asian Tatars, in touch only with its northern territories, knew China by this name and the Russians through contact with them introduced it into Europe. The Russians and the peoples of central Asia still know China as Khitai or Kitai. Although in Marco Polo's time all China was under the control of the Great Khan, he limits Cathay to the country north of the Yangtze valley, calling southern China by the separate name of Mangi. The distinction was at that time a real one, since Mangi retained the old Sung culture practically undiluted while Cathay bore the impress of the Tatar conquest. In the 16th century, however, when European navigators reached far eastern waters via the Spice Islands it was Mangi which they knew as China (this name is thought to have been derived by neighbouring peoples from the Chin dynasty, 3rd century B.C., but is not found in the Chinese language); and Cathay was understood to lie away to the north of it and to be reached by a still undiscovered sea route. Hence ensued the search for the northwest and northeast passages from Europe. This dualism corresponds to the distinction apparent in Roman literature between the Seres—the Chinese as approached by the overland route—and the Sinae—the Chinese as approached by the sea route from the south. Only in the early 17th century was the identity of the country and of the people reached by the two routes appreciated.

**CATHCART**, the name of a family of Scottish, and from 1807 of British, peers, of whom the following are historically most important:

**WILLIAM SCHAW CATHCART, 1ST EARL** (1755-1843), was born at Petersham, Sept. 17, 1755. Leaving Eton in 1771, he went to St. Petersburg, where his father, the 9th Baron Cathcart (1721-76), was ambassador. He succeeded to the barony in 1776 and, having studied law at Dresden and Glasgow, was admitted to the Scottish faculty of advocates. In 1777 he joined the army and commanded troops in America, the Netherlands and Germany. He later served as commander in chief in Ireland (1803-05), and led the British expedition to Hanover (1805). In 1806 he was sent on a diplomatic mission to Russia and in 1807 commanded the land forces in the Copenhagen expedition. After the capture of Copenhagen he was created Viscount Cathcart of Cathcart and Baron Greenwich of Greenwich. He was promoted general in 1812. In July of the same year he was appointed ambassador and military commissioner in Russia, where he remained until 1820. He was created earl in 1814. He died at his estate near Glasgow, June 16, 1843.

**CHARLES MURRAY CATHCART, 2ND EARL** (1783-1859), eldest son of the above, succeeded to the title in 1843. He saw distinguished service in the Napoleonic wars and was commander in chief in Canada from 1846 to 1849. Cathcart's interest in science led to his discovery in 1841 of a new mineral which was named greenockite.

**SIR GEORGE CATHCART** (1794-1854), third surviving son of the 1st earl, served in the Napoleonic campaigns of 1812-15 and in 1846 became deputy lieutenant of the Tower of London. In 1852 he was made governor of the Cape, where he completed Sir Harry Smith's task of subduing the Kaffirs. In 1854 he returned

to England and was sent to the Crimea in command of a division. He was killed at the battle of Inkerman.

**CATHEDRAL** (from Greek *καθῆδρα*, Latin *cathedra*, chair or throne) is an adjective frequently used as a noun to mean a cathedral church (*ecclesia cathedralis*); that is, a church in which a bishop has his official seat (*sedes*) or throne.

**Early Organization.**—A cathedral church is not necessarily a large church, but from the 4th century was supposed to be in a town, not in a village. In Britain in the age of conversion this was not usually possible because there were practically no towns, but after the Norman conquest a number of English cathedrals were moved from villages to the most important town in the diocese. Occasionally two churches jointly share the distinction of containing the bishop's *cathedra* and are therefore said to be co-cathedral in relation to each other. Examples are in Ireland at Christ church and St. Patrick's, Dublin, and in England before the Reformation at Bath and Wells and at Coventry and Lichfield. Cathedral churches are of different degrees of dignity: the simple cathedral church of a diocesan bishop; the metropolitan church to which other diocesan cathedral churches of a province are suffragan; the primatial church under which are metropolitan churches and their provinces; patriarchal churches to which primatial, metropolitan and simple cathedral churches alike owe allegiance. The title "primate" was occasionally conferred on metropolitans of sees of dignity and importance, such as Canterbury, York and Rouen, whose cathedral churches remained simply metropolitan.

The bishop by canon law was pastor of his cathedral church, which was the mother church (*matrix ecclesia*) of his diocese or, as it was called in early times, parish (*parochia*), a word used later for the parishes into which the diocese was divided. His cathedral clergy, which included priests, deacons, subdeacons and clerks in minor orders, originally formed his *familia* or household and lived a communal life with him, sharing the common goods of the church and helping to serve its large parish. They were not usually monks, but their communities were often described as *monasteria*, a word which then had a less restricted meaning than it later acquired. Because of this, churches such as York and Lincoln, which never had monks attached to them, inherited the name minster or monastery. In time the common life was abandoned and the clergy lived in separate houses, but in the 8th and early 9th centuries the revival of the common life in a stricter form was advocated by reformers in the Carolingian empire, chiefly as a means of enforcing celibacy among cathedral clergy. The most famous and successful rule for cathedral clergy at this time was that of Bishop Chrodegang of Metz, written about 755. It was based largely on the Benedictine rule, but was less strict in requirements for individual poverty. At the council of Aix-la-Chapelle, 817, it was chosen as the basis for a widespread adoption of a common life at cathedral and collegiate churches throughout the empire. In England it was introduced at Canterbury for a short time about 813, and at several other cathedral churches in the 11th century, before the Norman conquest. The clergy who followed it were called canons or canonical clerks because they observed a definite rule or canon (from Greek *κανών*, rule).

**Secular and Regular Cathedrals.**—From the 10th century two increasingly divergent movements can be traced in the history of the organization of communities of canons. On the one hand, attempts to enforce the common life met with more resistance and, in times of invasions, with unrest and relaxation of ecclesiastical discipline, many cathedral canons acquired private property, lived in separate houses and divided a large part of the common estates and goods of their church into separate portions or prebends (pro-vender) for themselves. Because of these separate possessions they were called "secular" canons. This division of common goods was recognized as permissible on the continent about the middle of the 11th century. However, this "secularizing" movement led, in the religious revival of the same period, to a renewed demand for clergy to live the communal apostolic life and, as a result, in the early 12th century many communities of canons adopted a strict form of common life under the rule of St. Augustine. They were

called "regular" (from Latin *regula*, rule) or Augustinian canons, and their life soon became barely distinguishable from that of Benedictine monks. From this time cathedral churches were normally organized on either a regular or a secular basis. On the greater part of the continent the regular cathedrals of the middle ages were served by Augustinian or Premonstratensian canons, though in parts of Germany and in Denmark some were served by Benedictine monks. In England the 10th-century monastic revival had resulted in the introduction of Benedictine monks to serve three or four cathedrals, and in the ecclesiastical reorganization following the Norman conquest these were increased to nine—Canterbury, Winchester, Worcester, Rochester, Bath, Coventry, Ely, Norwich, Durham; that is, nearly half the total number of English mediaeval cathedrals. In Ireland at Downpatrick and in Sicily at Monreale, Benedictine cathedral chapters were also founded in the late 12th century under Anglo-Norman influence. England had only one Augustinian cathedral, Carlisle, founded in 1133. Christ church, Dublin, in Ireland and St. Andrews in Scotland were Augustinian, while Whithorn, the cathedral church of Galloway, was Premonstratensian. All the other mediaeval cathedrals of Britain gradually became secular in the period following the Norman conquest. A secular organization was first introduced at Salisbury, Lincoln, York and London about 1089–91, and later spread to Wells, Lichfield, Chichester, Hereford and Exeter in England and to Elgin (Moray), Glasgow and Aberdeen in Scotland.

Neither in the regular nor secular mediaeval cathedrals was the early intimate association of bishop and cathedral clergy maintained. With the end of the missionary period of conversion and with the formation of parishes, the cathedral church lost its parochial character, and the interests of its clergy became centred in its services and government, while the bishop was increasingly drawn away on diocesan duties or affairs of state. The cathedral chapters always kept certain links with their bishop and diocese. They continued to act as permanent trustees of episcopal property; their consent was necessary to episcopal acts which involved financial arrangements of the church and see; they sometimes exercised episcopal jurisdiction in a vacancy of a see and in 1215 were recognized as having the sole right to elect their bishop. But from the 11th or 12th century most cathedral chapters controlled their own property, which was separate from that of the bishop, and assumed, especially in northern France and England, the position of independent corporations, jealous of their rights and privileges. Mediaeval English bishops were often afraid to adventure themselves in their cathedral cities for fear of conflicts with their chapters. In the regular chapters the bishop was in the position of titular abbot, but attempts by him to act as abbot were quickly resented. The convent of regular canons or monks formed the chapter, of which the prior was head, and its constitution and way of life was ordered by the Benedictine or Augustinian rule.

The constitutions of the secular cathedral chapters showed greater variety. Their two main characteristics were separate prebendal incomes for the canons and a system of home government at the cathedral based on a varying number of dignitaries, who divided the administrative work between them and were supposed to be continuously resident. The prebends were of varying value, but many were sufficient to enable canons to be nonresident and do work at a distance from the cathedral in the rapidly expanding administrations of kings, popes, archbishops and bishops, in the growing schools of the 12th century and in the universities of the 13th century. Nonresidence was soon regarded as lawful, for a canonry, unlike a dignity, was without cure of souls. Nonresident canons, however, were forbidden to share in the chapter's common fund, which was kept for the residentiaries, who bore the "heat and burden of the day" at the cathedral. By the 14th century in England secular cathedral canons were usually fairly clearly divided into two groups, residentiaries and nonresidentiaries, and the residentiaries might form about a quarter of the full body of 21 to 54 canons. By the 16th and 17th centuries, because of the increase in the common fund and the reduction of the residentiaries to a small fixed number of five to nine, residence at these cathedrals had become a privilege to which nonresident prebendaries eagerly awaited election, and government was almost entirely vested in the small inner chapter of residentiaries.

In England the constitutions of the nine mediaeval secular cathedrals became in the course of the 12th, 13th and 14th centuries remarkably homogeneous. They have been described as four square, because they





EARLY ENGLISH GOTHIC  
13TH CENTURY  
SALISBURY, SOUTH AISLE



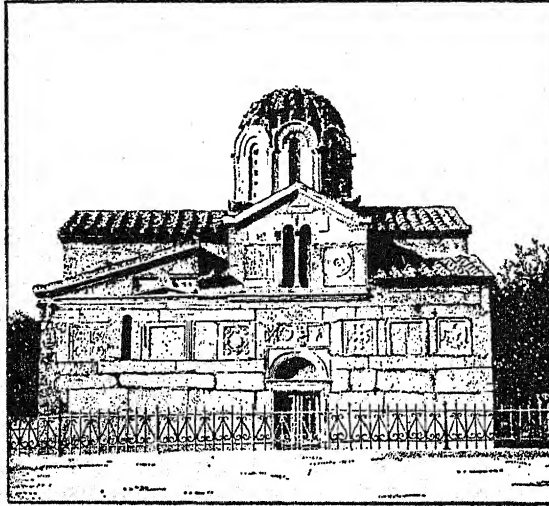
MODERN AMERICAN, COMPLETED EXTERIOR, ST. JOHN THE DIVINE, NEW YORK CITY  
(CRAM AND FERGUSON, ARCHITECTS, FOR THE COMPLETION, 1910 ET SEQ)  
(HEINS AND LAFARGE, ARCHITECTS, FOR OLDER PORTIONS, 1892 ET SEQ)



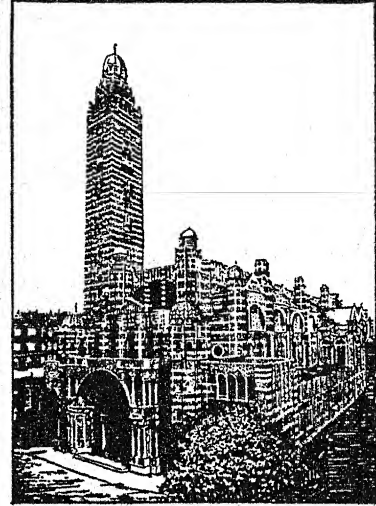
FRENCH GOTHIC  
13TH-14TH CENTURIES  
BEAUVAIS, THE CHOIR



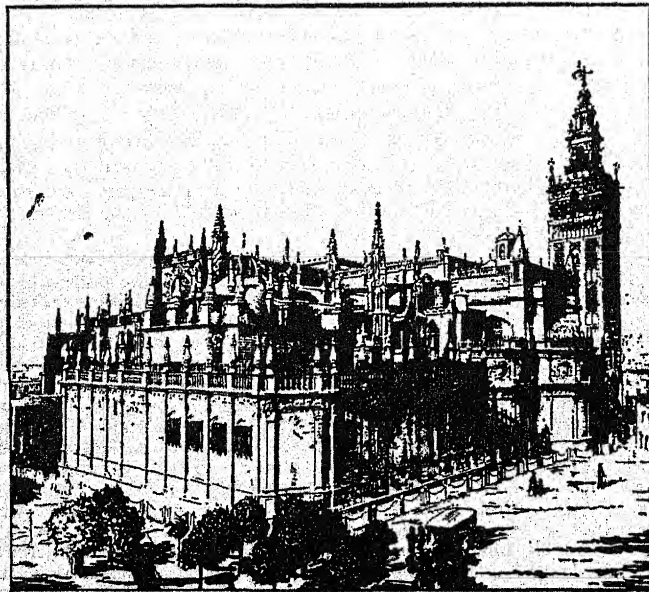
CATHEDRAL OF ST. BASIL  
MOSCOW, 1555-60  
(BARMA AND POSZNIK, ARCHITECTS)



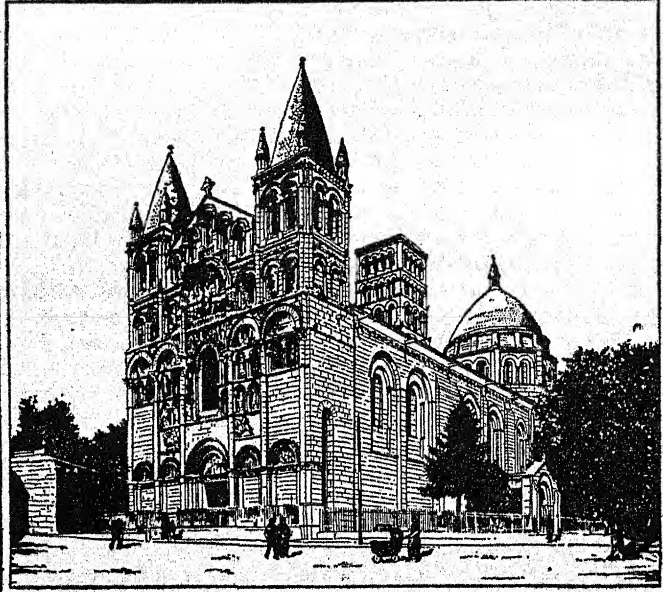
BYZANTINE, GREEK TYPE  
11TH CENTURY  
CATHEDRAL AT ATHENS



MODERN ENGLISH 1896 ONWARD  
WESTMINSTER CATHEDRAL, LONDON  
(G. F. MONTLEY, ARCHITECT)



SPANISH LATE GOTHIC AND RENAISSANCE  
14TH-16TH CENTURIES  
SEVILLE CATHEDRAL, SPAIN



FRENCH ROMANESQUE 12TH CENTURY  
LA CATHÉDRALE ST. PIERRE AT ANGOULÊME  
(RESTORED AND ALTERED, 19TH CENTURY)

#### EXAMPLES OF CATHEDRAL ARCHITECTURE FROM THE 11TH TO THE 20TH CENTURY

Although a cathedral is usually large, a small building can serve, as in the case of the tiny cathedral at Athens. Salisbury and Beauvais cathedrals represent English and French phases of Gothic; that of Seville shows the Spanish late-Gothic-Renaissance transitional style; the curious St. Basil's cathedral, Moscow, combines Byzantine and Italian Renaissance features with Russian timber-church and tartar motifs and purely fanciful elements; and Westminster cathedral (Roman Catholic) and the cathedral of St. John the Divine are modern adaptations of Byzantine and Gothic precedents.



were based on four great dignitaries who normally occupied the four terminal stalls in choir. The dean was president of the chapter and had cure of souls of all the cathedral clergy; the precentor was in charge of the music, liturgy and song school; the chancellor was the chapter's secretary and supervised the cathedral schools of grammar and theology; the treasurer guarded the church's treasures and provided lights and other material necessities for the services. Under these were various deputies and officers, such as a subdean, succentor, vice-chancellor, grammar master, lecturer in theology, subtreasurer and sacrist, with masters or wardens of the fabric and common funds, some of whom were canons while others were vicars choral or chanty chaplains. Vicars choral were appointed from the 12th century not only by nonresident but also by residentiary canons, and corresponded to the *heuriers*, *matiniers* and demiprebendaries of some French chapters, whose chief duties were to sing the services. By the later middle ages they were in effect the working staffs of the cathedrals and formed minor self-governing corporations under the wealthy controlling corporation of the chapter.

**English and Continental Development.**—The English cathedral constitutions in their origins at the end of the 11th century can have been derived only from cathedrals of Normandy or northern France, where similar dignitaries then performed roughly similar functions, though their numbers, status and precedence still varied and were unfixed, and no one Norman cathedral provided an exact model. The remarkable similarity of the English constitutions of the later middle ages seems, however, to have been the result not merely of a common origin or imitation of a Norman model, but also of independent development in England in the 12th and 13th centuries and of the growing practice by English chapters of borrowing and adopting each others' customs, particularly those of Salisbury. On the continent there was far greater diversity in constitutions and titles, of which Chartres, with dignitaries in the 14th century, or Milan, with an archpriest at the head of the chapter, archdeacon and four *primicerii*, are particularly good examples. Generally it seems that the strong independent chapter with a dean as sole head under the bishop developed first in northern France about the 10th and 11th centuries. Elsewhere about this time there was often a division between the spiritual authority in the chapter, exercised usually by a dean in Germany and the Low Countries and by an archpriest in southern France and Italy, and the temporal authority of a provost or archdeacon, who administered the capitular estates. In Germany, Scandinavia and parts of eastern and southern France the provost often later emerged as sole head of the chapter, while in Italy about half the cathedrals came to have an archdeacon at their head.

In France most of the regular cathedral chapters were secularized about the time of the Reformation. In England Henry VIII dissolved the monastic cathedral chapters and, except for Bath and Coventry, re-founded them as secular chapters under a dean with an organization suggested by that of English colleges of resident chantry priests in the later middle ages. These are called cathedrals of the New Foundation. He also founded six new cathedrals with similar constitutions in churches of dissolved monasteries at Bristol, Chester, Gloucester, Oxford, Peterborough and, for a time, Westminster. The nine mediaeval secular cathedrals, known as cathedrals of the Old Foundation, survived the Reformation with their constitutions practically unchanged; they underwent drastic changes and the loss of their prebendal estates by the Cathedrals act, 1840. Since 1836 3 ancient English collegiate churches, Ripon, Manchester and Southwell, and 18 parish churches (including the originally monastic churches of St. Albans and Southwark) have been converted into cathedrals of new dioceses, while new cathedrals have been built at Truro, Liverpool and Guildford.

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**Architecture.**—The architectural history of the west European cathedral begins with the first large Christian basilicas—old St. Peter's and others—built in Rome soon after Constantine's edict of 323. The long colonnaded nave drew the worshipper's attention irresistibly to the eastern apse where stood the main altar and, behind that, the bishop's throne, later moved to a chancel between apse and nave. In the metropolitan churches, though not usually those of other cities, this eastward drive was checked by the intrusion of a large transverse space called *bema*, forerunner of the mediaeval transept and serving both to give room for ceremonial deployment before the altar and to withdraw the mystical focus of the church a little from the congrega-

tion. In later centuries this longitudinal and apsidal plan continued in use, with modifications, for many cathedrals and abbey churches (it is impossible to isolate the development of strictly "cathedral" buildings); the cathedral of S. Apollinare in Classe, Ravenna (534-539), was of this type, as was such a Carolingian abbey as Fulda (begun 802).

Hardly any of the typical features of the French High Gothic cathedral would have been possible without preliminary development in the Romanesque period (c. 1000-1200). Thus the cluster of apsidal chapels jutting from a passage or ambulatory laid round the main apse—chapels made necessary by increasing worship of saints and the growing custom of each canon saying Mass daily—is traceable at least to St. Martin at Tours of 997-1020; Durham had rib vaults, Nevers (Burgundy) a form of flying buttress and Autun (in the same province) pointed arcades almost half a century before the rebuilding of St. Denis abbey, 1137-44, as the first of the large true Gothic churches of the Île de France. But in the High Gothic cathedral these features developed rapidly: nave vaulting (rediscovered in early Romanesque times to replace the inflammable flat timber roof of the basilicas) was lightened and carried to ever greater heights; translucent glass displaced solid stone wall. The eastward drive of the Early Christian church was replaced by an upward drive; Romanesque Durham was 80 ft. high to the crown of its vaults; Notre Dame, Paris (1163-1208) reached 115 ft.; Beauvais (1272) 157 ft. (but after later partial collapse remains a truncated naveless folly).

By comparison the English mediaeval cathedral is of modest proportions, long and low; set within a cloistered precinct proclaiming its monastic or collegiate origin (viz., Canterbury), not jutting up directly from the street; entered through a quiet north porch rather than the spectacular western figure portals of the Île de France. English west fronts, however, often had an impressive program of sculpture, as at Wells, Exeter and elsewhere.

The imagination of the Renaissance humanist-architect was captured anew by the aesthetic possibilities of the "central" plan; of a cathedral centrally domed and symmetrically disposed north, south, east and west—a plan fairly common in earlier times (St. Sophia, Constantinople, and S. Vitale, Ravenna, in the 6th century; Aachen cathedral of the 9th; St. Mark's, Venice, in the 12th). Bramante and Michelangelo proposed completely symmetrical plans for the rebuilding of St. Peter's at the end of the 16th century, but the traditional needs of the church compelled Carlo Maderna to add a long western nave when he completed the cathedral after 1600. Sir Christopher Wren was faced with a similar difficulty and forced to a similar modification in the rebuilding of St. Paul's cathedral, London (1675-1710).

Neither the 19th century nor the modern architectural movement beginning in the 1880s produced a special cathedral style. Most architects freely adapted historical styles such as the Byzantine (Westminster cathedral, J. F. Bentley, 1896 *et seq.*) and Gothic (Liverpool, Sir G. G. Scott, 1903 *et seq.*, and the remodelled St. John the Divine, New York city, R. A. Cram and F. W. Ferguson, 1910 *et seq.*). However, in his designs for the new Coventry cathedral (approved 1951, modified 1952-53) B. Spence mainly rejected traditional architectural styles and used tent forms, facet vaulting and other new features. (See also BYZANTINE AND ROMANESQUE ARCHITECTURE; GOTHIC ARCHITECTURE; RELIGIOUS AND MEMORIAL ARCHITECTURE.)

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**CATHELINEAU, JACQUES** (1759-1793), French Vendean chieftain during the Revolution, was born on Jan. 5, 1759, at Tin-en-Manges, Maine-et-Loire. In the first years of the Revolution, Cathelineau listened to the exhortations of Catholic priests and royalist *émigrés* and joined the insurrection provoked by them against the revolutionary government. Collecting a band of peasants and smugglers, he took the château of Gallais, where he captured a cannon, christened by the Vendéans the "Missionary"; he then took the towns of Chemillé, Cholet, Vihiers and Chalonnes (March 1793). His companions committed atrocities which brought upon them terrible reprisals on the part of the Republicans. Meanwhile Cathelineau's troops increased, and he combined with the other Vendean chiefs, such as N. Stofflet and M. L. J. Gigot d'Elbée, taking the towns of Beaupréau, Fontenay and Saumur. The first successes of the Vendéans were a result of the fact that the Republicans had not expected an insurrection. When the resistance to the insurgents became more serious differences arose among their leaders. To avoid these rivalries, it is thought that Cathelineau was named generalissimo of the rebels, though his authority over the undisciplined troops was not increased by the new office. In 1793 all the Royalist forces tried to capture Nantes. Cathelineau entered the town in spite of the resistance of Gen. J. B. Clanclaux,

but he was killed and the Vendean army broke up. Numerous relatives of Cathelineau also perished in the war of La Vendée. (See also CHOUANS; VENDÉE, WARS OF THE.)

See C. Port, "La Légende de Cathelineau," in *La Révolution française*, vol. xxiv (Paris, 1893); Abbé F. Charpentier, *Jacques Cathelineau, le Saint d'Anjou* (Paris, 1911).

**CATHER, WILLA SIBERT** (1876-1947), U.S. author, was born at Winchester, Va., on Dec. 7, 1876, and as a child of eight or nine was taken to a Nebraska ranch. After her graduation from the University of Nebraska in 1895, she taught English in the Allegheny high school, worked on the Pittsburgh *Leader* and travelled widely. Her first volume of stories, *The Troll Garden* (1905), led to an appointment as associate editor of *McClure's Magazine* (1906-12), which was then a vigorous periodical, a pioneer in the field of magazine journalism, less dignified than the old monthlies, but alive with the spirit of reform and direct appeal to an ever-increasing audience more interested in substance than in form. Miss Cather's first distinguished work in pure literature was *O Pioneers!* (1913), in which, on Sarah Orne Jewett's advice, she endeavoured to recapture "in memory, people and places" which she believed to be forgotten. With it she put herself in the forefront of those who had begun to realize the importance of pioneer life in America. *My Antonia* (1918) was another book with the same general background, which established her reputation as a novelist of unusual depth and power of beauty, who could see deep currents of emotion running in those Main Streets and prairies which Sinclair Lewis was to satirize for their decline into dullness. In *One of Ours* (1922), she stepped aside, not altogether successfully, to tell a story of a western boy in World War I. This novel was awarded a Pulitzer prize. *The Song of the Lark* (1925) was another pioneer story; *A Lost Lady* (1923) was also told against a prairie background, but its simplicity of telling, its depth of tragedy and fineness of insight into the secret and the weakness of woman's charm far outweigh the interest of its local colour. In *The Professor's House* (1925), she began experiments with a new technique of story-telling, constructing her story of an intellectual's soul development according to the familiar methods of music. In *Death Comes for the Archbishop* (1927), she told in the form of a chronicle a simple and vivid story of two saints of the southwest. This, *A Lost Lady*, *Shadows on the Rock* (1931), and *Lucy Gayheart* (1935) are her best books. Her short stories in the collection *Youth and the Bright Medusa* (1920) escape the stereotyping that has devitalized so many U.S. short-story writers. Her first book was in verse, *April Twilights* (1903); her first novel, *Alexander's Bridge* (1912). Among the writers who in the early 20th century deepened and refined the study of American character, Willa Cather was perhaps pre-eminent. Her style is restrained, sometimes almost cold, but rising into passages of great beauty, and always in harmony with her subject. Her themes are broader and more human than Edith Wharton's; her analysis of human motives deeper than Booth Tarkington's; and she was perhaps closer to essential Americanism in its spiritual and emotional aspects than any other contemporary writer. She is not rich in humour, nor pointed in satire, and in this differed from her nearest contemporaries, but she came closest in U.S. literature of this period to the classic ideal of balance, insight, restraint. She died April 24, 1947, in New York city.

See articles on her work by T. K. Whipple in *Spokesmen: Modern Writers and American Life*; A. Porterfield, *Contemporary American Authors*, edited by J. C. Squire; Elizabeth S. Sergeant, *Five Under the Andes* (1927). (H. S. C.)

**CATHERINE, SAINT.** The Roman hagiology contains seven saints of this name. 1. ST. CATHERINE OF ALEXANDRIA, virgin and martyr, whose day of commemoration recurs on Nov. 25. 2. ST. CATHERINE OF SIENA, 1347-80, Dominican tertiary whose feast is observed on April 30. 3. ST. CATHERINE OF SWEDEN, daughter of St. Bridget, who died abbess of Vadstena in 1381, and is commemorated on March 22. 4. ST. CATHERINE OF BOLOGNA, 1413-63, abbess of the Poor Clares in Bologna, canonized by Pope Clement XI, and mentioned in the Roman Martyrology on March 9. 5. ST. CATHERINE OF GENOA (1447-1510), who belonged to the

noble family of Fieschi, devoted her life to the sick, especially during the plague at Genoa in 1497 and 1501. She was beatified by Clement X in 1675 and canonized by Clement XII in 1737, her feast being on July 22. See F. von Hügel, *The Mystical Element in Religion as studied in St. Catherine of Genoa*, 2nd ed. (1923). 6. ST. CATHERINE DE' RICCI, of Florence (1522-1590), became a Dominican nun at Prato. She was famous during her lifetime for the weekly ecstasy of the Passion, during which she experienced the sufferings of the Holy Virgin contemplating the Passion of her Son. She was canonized in 1746 by Benedict XIV, who fixed her feast day on Feb. 13. In Celtic and English martyrologies (Nov. 25) there is also commemorated St. Catherine Audley (c. 1400), a recluse of Ledbury, Hereford. Pius XI in 1930 canonized ST. CATHERINE TOMAS (d. 1574), of Majorca.

Of the first two saints something more must be said. Of St. Catherine of Alexandria, history has little to tell. According to the legend recorded in the Roman martyrology, and in Simeon Metaphrastes, Catherine upbraided the Emperor Maximinus for his cruelties, and adjured him to give up the worship of false gods. The angry tyrant, unable to refute her arguments, sent for pagan scholars to argue with her, but they were discomfited. Catherine was then scourged and imprisoned. When the empress went to reason with her, Catherine converted her as well as the Roman general and his soldiers, who had accompanied her. Maximinus now ordered her to be broken on the wheel; but the wheel was shattered by her touch. The axe proved fatal, and the martyr's body was borne by angels to Mt. Sinai, where Justinian I. built the famous monastery in her honour. Another variation of the legend is that in which, having rejected many offers of marriage, she was taken to Heaven in vision and betrothed to Christ by the Virgin Mary.

Of these marvellous incidents very little, by the universal admission of Catholic scholars, has survived the test of modern criticism, though her actual existence is generally admitted. In the middle ages she was a most popular saint, her festival being, in certain dioceses of France, a holy day of obligation even as late as the 17th century. The wheel being her symbol, she was the patron saint of wheelwrights and mechanics, as well as the tutelary saint of nuns and maidens, and of philosophers.

St. Catherine of Siena, the youngest daughter of a dyer, was born on March 25, 1347. At an early age she began to practise asceticism and see visions, and when seven dedicated her virginity to Christ. In 1363 she became a Dominican tertiary, and renewed in her home the life of the anchorites in the desert. She resumed family life in 1366 when she began to tend the sick and the poor. Her peculiarities excited suspicion, and charges seem to have been brought against her by some of the Dominicans, to answer which she went to Florence in 1374, soon returning to Siena to tend the plague-stricken. At the invitation of the ruler of Pisa she visited that city in 1375 to arouse enthusiasm for the proposed crusade, and to prevent Pisa and Lucca joining the Tuscan league against the pope. Fra Raimondo relates that, after an ecstasy at Pisa, she told him she had received the *stigmata*, or imprint of the wounds of the crucified Christ, but by her prayer the marks were made invisible. In 1376, Catherine resolved to bring back Pope Gregory XI. from Avignon, attempting first by correspondence to reconcile Gregory and the Florentines, who had been placed under an interdict, and then going in person as the representative of the latter to Avignon. Gregory empowered her to treat for peace, but the Florentine ambassadors proved faithless. Catherine, however, was able to persuade the pope to return to Genoa and then to push on to Rome. There he found life very difficult, and in 1378 sent Catherine on an embassy to Florence, especially to the Guelph party. While she was urging the citizens to make peace with the pope there came the news of his death. During the troubles that ensued in Florence, Catherine nearly lost her life, and sorely regretted not winning her heart's desire, "the red rose of martyrdom." Peace was signed with the new pope, Urban VI., and Catherine, having accomplished her second great political task, went home to Siena. Thence on the outbreak of the schism Urban summoned her to Rome, where she quelled the revolt of the people and tried to win for Urban the support of Europe,

Under the great strain, she died on April 29, 1380, and was canonized by Pius II. in 1461.

Catherine lived on in her writings and disciples. Among the latter were her confessor and biographer, Fra Raimondo, later master-general of the Dominicans, William Flete, an ascetically-minded Cambridge man, Stephano Maconi, who became prior-general of the Carthusians, and the two secretaries, Neri di Landoccio and Francesco Malavolti. The last of her band of

reformers, Tommaso Caffarini, died in 1434, but the work was taken up by Savonarola. Catherine's writings consist of: (1) a dialogue entitled, *The Book of Divine Doctrine, given in person by God the Father, speaking to the mind of the most glorious and holy virgin Catherine of Siena, and written down as she dictated it in the vulgar tongue, she being the while entranced, and actually hearing what God spoke in her*. The book has a significant place in the history of Italian literature "In a language which is singularly poor in mystical works it stands with the *Divina Commedia* as one of the two supreme attempts to express the eternal in the symbolism of a day, to paint the union of the soul with the suprasensible while still imprisoned in the flesh."

(2) The prayers (26 in all) which are mostly mystical outpourings. (3) Letters, nearly 400, addressed to kings, popes, cardinals, bishops, conventual bodies, political corporations and individuals. By their historical importance, their spiritual fragrance, their literary value, and their beautiful Tuscan vernacular, the letters put their author almost on a level with Petrarch.

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**CATHERINE I.** (1683-1727), empress of Russia, was the daughter of a Lithuanian peasant named Skavronsky, who died when she was a child. Martha Skavronskaya became a servant in the home of Pastor Glück, the Protestant superintendent of the Marienburg district, and married a Swedish dragoon called Johan. When the Swedes evacuated Marienburg, Martha became one of the prisoners of war of Marshal Sheremetev, who sold her to Prince Menshikov, at whose house, Peter the Great became her lover. After the birth of their first daughter Catherine, Martha was received into the Orthodox Church, when she was rechristened under the name of Catherine Alexeyevna, the tsarevich Alexius being her godfather. She received the title *Gosudarinya* or sovereign (1710), and Peter, who had divorced the tsaritsa Eudoxia, married her in 1711. Henceforth the new tsaritsa was her husband's inseparable companion. She was with him during the campaign of the Pruth, and Peter always attributed the successful issue of that disastrous war to her courage and sang-froid. She was with him, too, during his earlier Caspian campaigns. He was devoted to her, and she was able to act as a buffer between the tsar and his advisers in his frequent accessions of rage.

By the *ukaz* of 1722 Catherine was proclaimed Peter's successor, to the exclusion of the grand-duke Peter, the only son of the tsarevich Alexius, and on May 7, 1724, was solemnly crowned empress-consort in the Uspensky cathedral at Moscow, on which occasion she wore a crown studded with no fewer than 2,564 precious stones, surmounted by a ruby, as large as a pigeon's egg, supporting a cross of brilliants. Within a few months

of her coronation a dangerously familiar flirtation with her gentleman of the chamber, William Mons, caused some scandal. Mons was decapitated and his severed head, preserved in spirits, was placed in the apartments of the empress, but she attended Peter during his last illness, and closed his eyes when he died (Jan. 28, 1725). She was at once raised to the throne by the party of Prince Menshikov and Count Tolstoy with the support of the Guards.

The great administrative innovation of Catherine's reign was the establishment of the *Verkhovny Tainy Sovyet*, or supreme privy council. The executive power was thus concentrated in the hands of a few persons, mainly of the party of Reform (*ukaz* of Feb. 26, 1726). The foreign policy of Catherine I. was principally directed by the astute Andrei Ostermann. Russia now found herself opposed to England, chiefly because Catherine protected Charles Frederick, duke of Holstein, and George I. found that the Schleswig-Holstein question might be reopened to the detriment of his Hanoverian possessions. In the spring of 1726, an English squadron was sent to the Baltic and cast anchor before Reval. The empress protested, and the fleet was withdrawn, but on Aug. 6 Catherine acceded to the anti-English Austro-Spanish league. Catherine died on May 16, 1727. Though quite illiterate, she was an uncommonly shrewd, sensible and good-tempered woman. Her personal extravagance was a byword.

See the authorities referred to *s. v.* PETER I.

**CATHERINE II.** (1729-1796), empress of Russia, known as CATHERINE THE GREAT, was the daughter of Christian Augustus, prince of Anhalt-Zerbst, and his wife, Johanna Elizabeth of Holstein-Gottorp. She was born at Stettin on May 2, 1729. Her baptismal name was Sophia Augusta Frederica. In 1744 she was taken to Russia, to be affianced to the grand-duke Peter (afterwards Peter III.), the nephew of the empress Elizabeth, and her recognized heir. Frederick the Great favoured the alliance, his object being to strengthen the friendship between Prussia and Russia, to weaken the influence of Austria and to ruin the chancellor Bestuzhev, who was a known partisan of the Austrian alliance. The diplomatic intrigue failed, but Elizabeth took a strong liking to Sophia, and the marriage was finally decided on. On June 28, 1744, she was received into the Orthodox Church at Moscow, and was renamed Catherine Alexeyevna. On the 29th she was formally betrothed, and was married on Aug. 21, 1745 at St. Petersburg. Her married life was wretched. Peter was subnormal in physique and in mind, and his wife despised him. She was a clever and ambitious girl, and was determined that nothing should stand in the way of her ambitions. She accepted the conditions of her marriage because it was the means to power. During the 17 years of her life as grand-duchess she matured her mind and avoided a breach with Elizabeth. For ten years the marriage was barren, and the only reason for supposing that the future tsar Paul, who was born on Oct. 2, 1754, was the son of Peter, is the strong similarity of their characters. Catherine had many lovers. The scandalous chronicle of her life was the commonplace of all Europe. Her most trusted agents while she was still grand-duchess, and her chief ministers when she became empress, were also her lovers.

The Empress Elizabeth died on Jan. 5, 1762. The grand-duke succeeded without opposition as Peter III. He committed every possible folly, grovelled before Frederick the Great, insulted the Church, and threatened to divorce Catherine. She refrained from open opposition and acted with the political prudence which she had shown as grand-duchess. In July Peter foolishly retired with his Holsteiners to Oranienbaum, leaving his wife at St. Petersburg. On the 13th and 14th of that month, a "pronunciamento" of the regiments of the guard removed him from the throne and made Catherine empress. She issued a manifesto in which she claimed to stand for the defence of Orthodoxy, and the glory of Russia. The guards were manipulated by the four Orlov brothers. The eldest, Gregory, was her recognized chief lover, and he was associated with his brother Alexis in the office of favourite. But the hatred felt for Peter III. was spontaneous, and Catherine had no need to do more than let it be known that she was prepared to profit by her husband's downfall. Peter was sent to a country



AFTER A WOODCUT FROM "CATHARINA DA SIENA," 1500

ST. CATHERINE OF SIENA



house at Ropcha, where he died on July 17 in the course of a scuffle during dinner. His custodian, Alexis Orlov, said he could not remember what happened. Catherine in a second manifesto said she had accepted the throne for the good of the country and remarked that autocracy was a danger if the ruler lacked the requisite qualities.

Catherine the Great ruled Russia for 34 years. Although born a German princess she identified herself completely with the Russian people. She was in the truest sense the successor of Peter the Great. Her private life was the object of unceasing curiosity and interest among her contemporaries, and a mass of literature has grown up around the subject of her lovers and her relations with them. Catherine was never dominated by her lovers who were the instruments of her policy; it was she who governed Russia, not her favourites. Her main interests were intellectual and political, and her love affairs subsidiary. She was the disciple and friend of the Encyclopaedists, especially of Voltaire, the reading of whose works had first awakened her mind. She corresponded with him, with D'Alembert, and, more voluminously, with F. M. Grimm, who spent nearly a year at her court in 1777-78. Grimm reports that her conversation was even more brilliant than her letters. Catherine also corresponded at intervals with Frederick the Great and with Joseph II. Her letters are graceful and witty, and they show real political and diplomatic insight. She was determined to make Russian society as cultivated as the society of Paris and Berlin. At court she insisted on a high standard of decorum and of manners, she encouraged the nobles to travel, and fostered the love of French culture. She herself employed Grimm and others to collect works of art and antiquities for her, and practised sculpture and painting herself. She had a passion for reading, made a digest of Blackstone's *Commentaries* and found Buffon's *Histoire naturelle* light reading. Her enthusiasm for Russian history led her to begin to write a history of Russia from the earliest times, and she completed a play, having for its hero the legendary Oleg, which she said was an imitation of Shakespeare. Her comedies, proverbs, and tales are very numerous. To find time for all her activities she rose at five, made her own fire, and would sometimes work 15 hours a day. She seemed to have worked in bouts, taking long spells of work with intervals of relaxation. The new culture which she sought to impose on her court was not entirely superficial. She herself was kind and reasonable to her servants. She was not revengeful, and when she usurped the throne showed no hostility to her husband's advisers; nevertheless she had a fund of hardness, and showed little kindness to her son Paul.

Since Catherine was a disciple of the Encyclopaedists it was natural that she should start out with the definite intention of carrying out domestic reform in Russia, though by methods of the benevolent despotism fashionable in Europe in the period before the French Revolution shook the fabric of society. In fact she, a foreigner and usurper, had to depend for support on the nobility, whose privileges she vastly increased by relieving them of the duty of military service and giving them new powers over their serfs. She also increased their numbers by grants of Crown lands. Serfdom was not mitigated, but vastly increased under her rule. The terrible condition of the peasants led to one revolt after another in favour of one of the numerous pretenders, which culminated in the widespread rising on the Volga, the jacquerie led by Pugachev (1773-75). French culture among the landowners did not lead to any improvement in the handling of the peasants. This state of affairs was in startling contrast with the humanitarian tone of the *Instructions* which Catherine drew up for the grand commission which she summoned in Dec. 1766 to Moscow to advise on internal reform. The *Instructions*, based principally on the works of Montesquieu and Beccaria, were so radical that their circulation in France was forbidden. Very little came of the 18 months' work of the grand commission, except in the development of the organization of local government. With the outbreak of the French Revolution Catherine, like other European sovereigns, fell back on methods of repression. Radishchev, who wrote in his *Journey from St. Petersburg to Moscow* (1790) a truthful account of the condition of the peasants, was banished

to Siberia, though the sentiments expressed were only those of Catherine's own *Instructions* of 1766. Catherine had some able assistants in her domestic administration, notably Siviers.

The foreign policy of her reign aimed at the expansion of Russia, and from that point of view was brilliantly successful. Catherine knew the limits to which she could safely go in the "russification" of frontier districts, and showed a certain liberality to the populations which she incorporated. She conducted her own foreign policy, and the galaxy of excellent soldiers and diplomats which she gathered round her carried out her instructions implicitly. She had the gift of discovering ability, and kept in the closest touch with all her servants. Among her generals were Alexander Galitsin, Rumyantsev, Peter Panin, Suvorov, and Potemkin. Suvorov was one of the greatest of Russian generals, but he never enjoyed quite the confidence she gave to Potemkin, whose military abilities were mediocre, but who was first her lover and then her close friend and correspondent. Her chief advisers and assistants in foreign business were Nikita Panin, Bezborodko, Repnin, Dmitri Galitsin and Vorontsoff. The story of the two shameless partitions of Poland and of the wars with Turkey which gave Russia the Crimea and free access to the Black sea for the products of the Ukraine is told under RUSSIA: *History*. It is sufficient to say here that the extension of Russian territory during her reign to the Niemen and the Dniester on the west, and to the Black sea on the south must be placed primarily to the account of Catherine's diplomacy and direction, well served as she was by her generals and her ministers.

She died on Nov. 10, 1796, of apoplexy.

The original sources for the history of her policy and her character are to be found in the publications of the Imperial Russian Historical Society, vols. i.-cix. (St. Petersburg), begun in 1867; her private and official correspondence will be found in vols. i., ii., iv., v., vi., vii., viii., ix., x., xiii., xiv., xv., xvii., xx., xxiii., xxxii., xxxiii., xxxvi., xlii., xliii., xlvii., xlviii., li., lvii., lviii., lxxvii., lxxviii., xcvi., xcvi., cxv., cxviii. The *Mémoires de l'impératrice Catherine II., écrits par elle-même* (London 1859), with pref. by Alex. Herzen, bring her life up to the end of 1759, but were not begun until 1780. They must be used with caution, especially as regards her husband Peter III. See also A. Brückner, "Katharina die Zweite," in *Allgemeine Geschichte in Einzeldarstellungen* (Berlin 1883); O. Hoetzsch, "Catherine II.," in *Camb. Mod. Hist.* vol. vi., where a bibliography will be found. A complete bibliography was prepared by B. von Bilbassoff, *Katharina II., Kaiserin von Russland in Urtheile der Weltliteratur* (Berlin, 1897). See also Princesse Lucien Murat, *La vie amoureuse de la grande Catherine* (1927); *Mémoires*, trs. by Katherine Anthony (1927); *Correspondence with Sir Charles Hanbury-Williams*, ed. and trans. by the Earl of Ilchester and Mrs. Langford-Brooke (1928).

**CATHERINE DE MEDICI** (1519-1589), queen of France, was born in Florence in 1519. She was a daughter of Lorenzo II. de Medici and a French princess, Madeleine de la Tour d'Auvergne. Having lost both her parents at an early age, Catherine was sent to a convent to be educated; and she was only 14 when she was married (1533) at Marseilles to the duke of Orleans, afterwards Henry II. It was her uncle, Pope Clement VII., who arranged the marriage with King Francis I., Henry's father, who was glad to strengthen his influence in the Italian peninsula. For ten years after her marriage she had no children. In consequence, a divorce began to be talked of at court. But Catherine had the happiness of bringing her husband grandchildren ere he died. During his reign (1547-59), Catherine lived a quiet and passive but observant life. Henry being completely under the influence of his mistress, Diane de Poitiers, she had little authority. In 1552, when the king left the kingdom for the campaign of Metz, she was nominated regent, but with very limited powers. This continued even after the accession of her son Francis II. Francis was under the spell of Mary Stuart, and she, little disposed to meddle with politics on her own account, was managed by her uncles, the cardinal of Lorraine and the duke of Guise. The queen-mother, however, soon grew weary of the domination of the Guises, and entered upon a course of secret opposition. On April 1, 1560, she placed in the chancellorship Michel de l'Hôpital (*q.v.*), who advocated the policy of conciliation.

On the death of Francis (Dec. 15, 1560), Catherine became regent during the minority of her second son, Charles IX. She was then 41 years old, but, although she was the mother of nine children, she was still very vigorous and active. She retained her in-



fluence for more than 20 years in the troubled period of the wars of religion. At first she listened to the moderate counsels of l'Hôpital in so far as to avoid siding definitely with either party. Like so many of the Italians of that time she looked upon statesmanship as a career in which finesse, lying and assassination were the most effective weapons. By habit a Catholic, but above all things fond of power, she was determined to prevent the Protestants from getting the upper hand, yet resolved not to allow them to be utterly crushed, in order to use them as a counterpoise to the Guises. This trimming policy met with little success; rage and suspicion so possessed men's minds that she could no longer control the opposing parties, and one civil war followed another to the end of her life.

In 1567, after the "Enterprise of Meaux," she dismissed l'Hôpital and joined the Catholic Party. But, having failed to crush the Protestant rebellion by arms, she resumed in 1570 the policy of peace and negotiation. She conceived the project of marrying her favourite son, the duke of Anjou, to Queen Elizabeth of England, and her daughter Margaret to Henry of Navarre. To this end she became reconciled with the Protestants, and allowed Coligny to return to court and to re-enter the council. Of this step she quickly repented. Charles IX. conceived a great affection for the admiral and showed signs of taking up an independent attitude. Catherine, thinking her influence menaced, sought to regain it, first by the murder of Coligny, and, when that had failed, by the massacre of St. Bartholomew (*q.v.*). The chief responsibility for this crime, therefore, rests with Catherine; unlike the populace, she had not even the excuse of fanaticism. After the death of Charles in 1574, and the succession of Anjou under the name of Henry III., Catherine pursued her old policy of compromise and concessions; but as her influence is lost in that of her son, it is unnecessary to dwell upon it. She died on Jan. 5, 1589, a short time before the assassination of Henry, and the consequent extinction of the House of Valois.

In her taste for art and her love of magnificence and luxury, Catherine was a true Medici; in architecture especially she was well versed, and Philibert de l'Orme relates that she discussed with him the plan and decoration of her palace of the Tuileries. Catherine's policy provoked a crowd of pamphlets, the most celebrated being the *Discours merveilleux de la vie, actions et déportemens de la reine Catherine de Medicis*, in which Henri Estienne undoubtedly collaborated.

See *Lettres de Catherine de Medicis*, edited by Hector de la Ferrière (1880-1905), in the *Collection de documents inédits sur l'histoire de France*; A. von Reumont, *Die Jugend Caterinas de Medici* (1854; French trans. A. Baschet, 1866); H. Bouchot, *Catherine de Medicis* (1899). For a more complete bibliography see Ernest Lavisse, *Histoire de France* (vol. v., by H. Lemonnier, and vol. vi. by J. H. Mariéjol, 1904-05). See also the books of E. Sichel, *Catherine de Medici and the French Reformation* (1905) and *The Later Years of Catherine de Medici* (1908); J. H. Mariéjol, *Catherine de Medicis* (1920); L. Romier, *Le Royaume de Catherine de Medicis, etc.* (1921); P. Van Dyke, *Catherine de Medicis* (1923).

**CATHERINE OF ARAGON** (1485-1536), queen of Henry VIII. of England, daughter of Ferdinand and Isabella of Spain, was born on Dec. 15, 1485. She left Spain in 1501 to marry Arthur, prince of Wales, eldest son of King Henry VII., and landed at Plymouth on Oct. 2. The wedding took place on Nov. 14 in London, and soon afterwards Catherine accompanied her husband to Wales, where, in his 16th year, the prince died on April 2, 1502. On June 25, 1503, she was formally betrothed to the king's second son, Henry, now prince of Wales, and a papal dispensation for the alliance was obtained. The marriage, however, did not take place during the lifetime of Henry VII. Ferdinand endeavoured to cheat the English king of the marriage portion agreed upon, and Henry made use of the presence of the unmarried princess in England to extort new conditions, and especially to urge the marriage of his daughter Mary to the archduke Charles, grandson of Ferdinand, and afterwards Charles V. Catherine was thus from the first the unhappy victim of state politics. Writing to Ferdinand on March 9, 1509, she describes the state of poverty to which she was reduced, and declares the king's unkindness impossible to be borne any longer.

Henry VIII. married her on June 11, 1509. At first he showed

himself an affectionate husband, and the alliance with Ferdinand was maintained against France. During Henry's invasion of France in 1513 she was made regent; she made the preparations for the Scottish expedition, and was riding north to put herself at the head of the troops when the victory of Flodden Field ended the campaign. After Henry's return next year there was a breach with Ferdinand, and the king angrily reproached his wife; but she took occasion in 1520, during the visit of her nephew Charles V. to England, to urge the policy of gaining his alliance rather than that of France. Immediately on his departure, on May 31, 1520, she accompanied the king to France, on the visit to Francis I., when the sovereigns met at the Field of the Cloth of Gold; but in 1522 war was declared against France and the emperor again welcomed to England. She is represented by Shakespeare as pleading in 1521 for the unfortunate duke of Buckingham. Between Jan. 1510 and Nov. 1518 Catherine gave birth to six children (including two princes), who were all stillborn or died in infancy except Mary, born in 1516, and opinion ascribed this series of disasters to the curse on incestuous unions. To avoid a fresh dispute concerning the succession, and the revival of the civil war, a male heir to the throne was a pressing necessity. The question of the possible dissolution of the marriage occupied Henry's mind. It was doubtful whether the pope had the power to legalize his marriage with Catherine, his brother's betrothed, and the case for the desired divorce was therefore more hopeful.

Rumours, probably then unfounded, of an intended divorce had been heard abroad as early as 1524. But the creation in 1525 of the king's illegitimate son Henry, as duke of Richmond—the title borne by his grandfather Henry VII.—and the precedence granted to him over all the peers as well as the princess Mary, together with the special honour paid at this time by the king to his own half-sister Mary, were the first real indications of the king's thoughts. In 1526, and perhaps earlier, Wolsey had been making tentative inquiries at Rome on the subject. In May 1527 a colusive and secret suit was begun before the cardinal, who, as legate, summoned the king to defend himself from the charge of cohabitation with his brother's wife; but these proceedings were dropped. On June 22 Henry informed Catherine that they had been living in mortal sin and must separate. During Wolsey's absence in July at Paris, where he had been commissioned to discuss vaguely the divorce and Henry's marriage with Renée, daughter of Louis XII., Anne Boleyn (*q.v.*) is first heard of in connection with the king, his affection for her having, however, begun probably as early as 1523, and the cardinal on his return found her openly installed at the court. In October 1528 the pope issued a commission to Cardinal Campeggio and Wolsey to try the cause in England, and bound himself not to revoke the case to Rome, confirming his promise by a secret decretal commission which, however, was destroyed by Campeggio. But the trial was a sham. Campeggio was forbidden to pronounce sentence without further reference to Rome, and was instructed to create delays, the pope assuring Charles V. at the same time that the case should be ultimately revoked to Rome.

The object of all parties was now to persuade Catherine to enter a nunnery and thus relieve them of further embarrassment. While Henry's envoys were encouraged at Rome in believing that he might then make another marriage, Henry himself gave Catherine assurances that no other union would be contemplated in her lifetime. But Catherine with courage and dignity held fast to her rights, demanded a proper trial, and appealed not only to the bull of dispensation, the validity of which was said to be vitiated by certain irregularities, but to a brief granted for the alliance by Pope Julius II. Henry declared the latter to be a forgery, and endeavoured unsuccessfully to procure a declaration of its falsity from the pope. The court of the legates accordingly opened on May 31, 1529, the queen appearing before it on June 18 for the purpose of denying its jurisdiction. On the 21st both Henry and Catherine presented themselves before the tribunal, when the queen threw herself at Henry's feet and appealed for the last time to his sense of honour, recalling her own virtue and helplessness. Henry replied with kindness, showing that her wish for the revocation of the cause to Rome was unreasonable in view of the

paramount influence then exercised by Charles V. on the pope Catherine nevertheless persisted in making appeal to Rome, and then withdrew. After her departure Henry, according to Cavendish, Wolsey's biographer, praised her virtues to the court. "She is, my lords, as true, as obedient, as conformable a wife as I could in my phantasy wish or desire. She hath all the virtues and qualities that ought to be in a woman of her dignity or in any other of baser estate." On her refusal to return, her plea was overruled and she was adjudged contumacious, while the sittings of the court continued in her absence. Subsequently the legates paid her a private visit of advice, but were unable to move her from her resolution. Finally, however, in July 1529, the case was, according to her wish, and as the result of the treaty of Barcelona and the pope's complete surrender to Charles V., revoked by the pope to Rome: a momentous act, which decided Henry's future attitude, and occasioned the downfall of the whole papal authority in England. On March 7, 1530 Pope Clement issued a brief forbidding Henry to make a second marriage, and ordering the restitution of Catherine to her rights till the cause was determined; while at the same time he professed to the French ambassador, the bishop of Tarbes, his pleasure should the marriage with Anne Boleyn have been already made, if only it were not by his authority (Cal. of State Papers, For. and Dom. iv., 6290). The same year Henry obtained opinions favourable to the divorce from the English, French and most of the Italian universities, but unfavourable answers from Germany, while a large number of English peers and ecclesiastics, including Wolsey and Archbishop Warham, joined in a memorial to the pope in support of Henry's cause.

Meanwhile, Catherine was still treated by Henry as his queen. On May 31, 1531 she was visited by 30 privy councillors, who urged the trial of the case in England, but they met only with a firm refusal. On July 14 Henry left his wife at Windsor, removing himself to Woodstock, and never saw her again. In August she was ordered to reside at the Moor in Hertfordshire, and at the same time separated from the princess Mary, who was taken to Richmond. In October she again received a deputation of privy councillors, and again refused to withdraw the case from Rome. In 1532 she sent the king a gold cup as a new year's gift, which the latter returned, and she was forbidden to hold any communication with him. Her cause found champions and sympathizers among the people, among the court preachers, and in the House of Commons, while Bishop Fisher had openly taken her part in the legatine trial. Subsequently Catherine was removed to Bishops Hatfield, while Henry and Anne Boleyn visited Francis I. Their marriage, anticipating any sentence of the nullity of the union with Catherine, took place after their return about Jan. 25, 1533. On May 10 Archbishop Cranmer, opened his court, and declared on the 23rd the nullity of Catherine's marriage and the validity of Anne's. On Aug. 10 the king caused proclamation to be made forbidding her the style of queen; but Catherine refused to yield the title for that of princess-dowager. Not long afterwards she was removed to Buckden in Huntingdonshire. Here her household was considerably reduced, and she found herself hemmed in by spies, and in fact a prisoner. A project for removing Catherine from Buckden to Somersham, in the isle of Ely, with a still narrower maintenance, was prevented by her resistance. The attempt in November to incriminate the queen in connection with Elizabeth Barton failed.

She passed her life now in religious devotions. On March 23, 1534 the pope pronounced her marriage valid, but by this time England had thrown off the papal jurisdiction, the parliament had transferred Catherine's jointure to Anne Boleyn, and the decree had no effect on Catherine's fortunes. She refused to swear to the new act of succession, which declared her marriage null and Anne's infant the heir to the throne, and soon afterwards she was removed to Kimbolton, where she was well treated. On May 21 she was visited by the archbishop of York and Tunstall, bishop of Durham, who vainly threatened her with death if she persisted in her refusal. She was kept in strict seclusion, separated from Mary and from all outside communications, and in Dec. 1535 her health gave way. She died on Jan. 8, 1536, not without suspicions of poison, which, however, may be dismissed. She was buried by the

king's order in Peterborough cathedral. Before her death she dictated a last letter to Henry, according to Polydore Vergil, expressing her forgiveness, begging his good offices for Mary, and concluding with the astounding assurance—"I vow that mine eyes desire you above all things." The king himself affected no sorrow at her death, and thanked God there was now no fear of war.

Catherine is described as "rather ugly than otherwise; of low stature and rather stout; very good and very religious, speaks Spanish, French, Flemish, English; more beloved by the islanders than any queen that has ever reigned." She was a woman of considerable education and culture, her scholarship and knowledge of the Bible being noted by Erasmus, who dedicated to her his book on *Christian Matrimony* in 1526. She endured her bitter and undeserved misfortunes with extraordinary courage and resolution, and at the same time with great womanly forbearance, of which a striking instance was the compassion shown by her for the fallen Wolsey.

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**CATHERINE OF BRAGANZA** (1638–1705), queen consort of Charles II. of England, daughter of John IV. of Portugal by Louisa de Gusman, daughter of the duke of Medina Sidonia, was born at Villa Viçosa on Nov. 25, 1638. She was a useful medium for contracting an alliance with England, and negotiations for a marriage, begun during the reign of Charles I., were renewed immediately after the Restoration. On June 23, 1661, in spite of Spanish opposition, the marriage contract was signed, by which England secured Tangier and Bombay, certain trading privileges, religious and commercial freedom in Portugal, and two million Portuguese crowns (about £300,000), in return for military and naval support to be given to Portugal against Spain, and liberty of worship for Catherine; in May 1662 she reached England, and the marriage took place in London. Catherine had little personal charm, and Charles's preoccupation with his mistresses soon led her to withdraw from his society; her intention of returning to Portugal was thwarted by the dismissal of her Portuguese retinue, and she was forced to pass a life of neglect and retirement in the midst of the debaucheries of the court. As the prospect of her bearing children diminished, schemes were set on foot to procure a divorce on various pretexts. As a Roman Catholic Catherine was attacked by the inventors of the Popish Plot; in 1678 the murder of Sir Edmund Berry Godfrey was ascribed to her servants, and Titus Oates accused her of a design to poison the king. On Nov. 28 Oates brought a charge of high treason against her, the Commons passed an address for her removal from Whitehall and it was only the king's protection that saved her from having to stand her trial in June 1679. On Nov. 17 in the House of Lords, Shaftesbury moved for a divorce, so that Charles might marry a Protestant, but the bill was opposed by the king. After the Oxford parliament Charles's influence revived, and the queen's position was no more assailed.

During Charles's last illness in 1685 Catherine did much to assist his reconciliation with the Catholic Church, and she exhibited great grief at his death. She afterwards resided at Somerset House and at Hammersmith, where she had privately founded a convent. She interceded with great generosity, but ineffectually, for Monmouth the same year. On June 10, 1688, she was present at the birth of the prince of Wales and gave evidence before the council in favour of the genuineness of the child. She maintained at first good terms with William and Mary; but the practice of her religion aroused jealousies, while her establishment at Somerset House was said to be the home of cabals against the Government; and in 1691 she settled for a short time at Euston. She left England finally in March 1692 and arrived at Lisbon in Jan. 1693. She took her residence at the palace of Bemposta, built by herself, near Lisbon. In 1703 she supported the Methuen Treaty, which cemented still further the alliance between Portugal and England, and in 1704 she was appointed regent of Portugal during the illness of her brother, King Pedro II., her administration

being distinguished by several successes gained over the Spaniards. She died on Dec. 31, 1705, bequeathing her great wealth, the result of long hoarding, after the payment of divers charitable legacies, to King Pedro; and was buried with great ceremony and splendour at Belem.

See L. C. Davidson, *Catherine of Braganza* (1908).

**CATHERINE OF VALOIS** (1401–1437), queen of Henry V. of England, daughter of Charles VI. of France by Isabel of Bavaria, was born in Paris on Oct. 27, 1401, and was educated in a convent at Poissy. After negotiations for a marriage between Henry, prince of Wales, afterwards Henry V., and each of her two elder sisters, had broken down, Henry IV. proposed that his son should marry Catherine in 1413, and Henry V. renewed this proposal when he became king in March of the same year, demanding at the same time a large dowry and the restoration of Normandy, and other territories in France. War broke out, on the rejection of these demands, but finally, after the treaty of Troyes, Henry and Catherine were betrothed on May 21, 1420, and married at Troyes, June 2, 1420. Catherine was crowned in Westminster Abbey on Feb. 23, 1421, and gave birth to a son, afterwards Henry VI., in the following December. In May 1422 she joined Henry in France, and after his death in the following August, she returned to England. Her name began to be coupled, now, with that of Owen Tudor, a Welsh squire, and when in 1428 Humphrey, duke of Gloucester, secured the passing of an act to prevent her from marrying without the consent of the king and council, she seems already to have been married to Tudor. In 1436 Tudor was imprisoned and Catherine retired to Bermondsey Abbey, where she died on Jan. 3, 1437. By Tudor Catherine had three sons and a daughter; the eldest son, Edmund, created earl of Richmond in 1452, was the father of Henry VII.

See Agnes Strickland, *Lives of the Queens of England*, vol. iii. (1877).

**CATHETUS**, in architecture, the central circular form round which the volute or spiral of the Ionic or Composite order twists.

**CATHODE**, the conductor by which an electric current leaves an electrolyte (*q.v.*) or a discharge tube. It is also called the "negative" electrode. (See also ANODE; ELECTRICITY, CONDUCTION OF: *Conduction in Liquids and Conduction in Gases.*)

**CATHODE RAYS** are the streams of negatively charged particles leaving the cathode in a discharge tube containing a gas at a low pressure (see ELECTRICITY, CONDUCTION OF: *Conduction in Gases*). The cathode rays consist of electrons (see ELECTRON). Cathode rays have many applications, one of the chief being the excitation of X-rays by the impinging of swift electrons against a hard anticathode (see also COOLIDGE TUBE; X-RAYS, NATURE OF; SPECTROSCOPY, X-RAY). This bombardment, besides exciting X-rays, generates a considerable amount of heat and the anticathode can be used as a *cathode ray furnace* for melting small quantities of metal, etc. Forms of apparatus making use of the deflection of a beam of cathode rays by magnetic and electric fields are the *cathode ray oscillograph*, or cathode ray tube, which indicates the variation and values of an alternating current or voltage (see INSTRUMENTS, ELECTRICAL), and the *cathode ray manometer*, in which a change of pressure is communicated to tourmaline crystals which become electrically charged (see ELECTRICITY) and produce an electric field which is measured by a cathode ray oscillograph.

**CATHOLIC**, derived from a Greek word meaning "universal" and used by ecclesiastical writers since the 2nd century to distinguish the Church at large from local communities or heretical and schismatic sects. A notable exposition of the meaning of the term, as it had developed during the first three centuries, was given by Cyril of Jerusalem (348): the Church is called catholic on the fourfold ground of its world-wide extension, its doctrinal completeness, its adaptation to the needs of men of every kind, and its moral and spiritual perfection (*Catech.*, xviii., 23). The theory that what has been universally taught or practised is true was first fully developed by St. Augustine in his controversy with the Donatists (393–420), but it received classic expression in a paragraph of St. Vincent of Lerin's *Commonitorium*, ii., 6 (434), from which the well-known formula, *quod ubique, quod*

*semper, quod ab omnibus creditum est*, is derived. St. Vincent maintained—curiously enough *à propos* of an extreme Augustinian theory of grace—that the true faith was that which the Church professed throughout the world in agreement with antiquity and the consensus of distinguished theological opinion in former generations (*cf. op. cit.*, ii. 3, 6, xx.). Thus the term tended to acquire the sense of orthodox.

Some confusion in the history of the term has been inevitable as various groups, which have been condemned by Rome as heretical or schismatic, have not renounced their claim to the note of catholicity, so that in the modern world not only the Roman Catholic Church but also the Eastern Orthodox Church, the Anglican Church, and a variety of national Churches and minor sects claim to be Catholic, if not the only true Catholic Church. From this point of view the meaning attached to the term "Catholic" and the claim to catholicity will be conditioned by the theory of the nature and constitution of the Church accepted, being rigid and exclusive or tolerant and comprehensive as that is rigid or tolerant. The earlier theologians of the Anglican Church were primarily interested in proving the agreement of the Anglican theology with the teaching of the ante-Nicene Fathers, but with the Oxford Movement a school of theologians arose who interpreted the catholicism of the Church of England in a much wider sense. A product of this school was the so-called "Branch Theory" of the Church, which maintained that the Anglican, Roman, and Eastern Orthodox Churches were all branches of the one true Catholic Church, and that reunion could be achieved by concessions of these three divisions on controversial questions which divided them without affecting their catholic character. But this theory has been repeatedly condemned by Roman theologians. It has also failed to recommend itself to the Eastern Orthodox Church.

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**CATHOLIC APOSTOLIC CHURCH, THE**, a religious community often called "Irvingites," though neither actually founded nor anticipated by Edward Irving (*q.v.*). Irving's relation to this community was, according to its members, somewhat similar to that of John the Baptist to the early Christian Church, *i.e.* he was the forerunner and prophet of the coming dispensation, not the founder of a new sect; and indeed the only connection which Irving seems to have had with the existing organization of the Catholic Apostolic body was in "fostering spiritual persons who had been driven out of other congregations for the exercise of their spiritual gifts." Shortly after Irving's trial and deposition (1832), certain persons were, at some meetings held for prayer, designated as "called to be apostles of the Lord" by certain others claiming prophetic gifts. In the year 1835, six months after Irving's death, six others were similarly designated as "called" to complete the number of the "twelve," who were then formally "separated," by the pastors of the local congregations to which they belonged, to their higher office in the universal church on the 14th of July 1835. This separation is understood by the community not as "in any sense being a schism or separation from the one Catholic Church, but a separation to a special work of blessing and intercession on behalf of it." The "apostles" always held the supreme authority, though, as their number dwindled, "coadjutors" were appointed to assist the survivors, and to exercise the functions of the "apostolate." The last "apostle" died on the 3rd of February 1901.

For the service of the church a comprehensive book of liturgies and offices was provided by the "apostles." It dates from 1842 and is based on the Anglican, Roman and Greek liturgies. Lights, incense, vestments, holy water, chrism, and other adjuncts of worship are in constant use. The ceremonial in its completeness may be seen in the church in Gordon Square, London, and elsewhere. The community has always laid great stress on symbolism, and in the eucharist, while rejecting both transubstantiation and consubstantiation, holds strongly to a real (mystical) presence. It



stresses also the "phenomena" of Christian experience and deems miracle and mystery to be of the essence of a spirit-filled church.

Each congregation is presided over by its "angel" or bishop (who ranks as angel-pastor in the Universal Church); under him are four-and-twenty priests, and with these are the deacons, seven of whom regulate the temporal affairs of the church—besides whom there are also "sub-deacons, acolytes, singers and door-keepers." The priesthood is supported by tithes.

See J. G. Simpson, art. "Irving and the Catholic Apostolic Church" in Hastings' *Encyclopaedia of Religion and Ethics*; and for further details of doctrines, ritual, etc., R. N. Bosworth, *Restoration of Apostles and Prophets, Readings on the Liturgy, The Church and Tabernacle and The Purpose of God in Creation and Redemption* (6th ed., 1888); G. Miller, *History and Doctrines of Irvingism* (1878).

**CATHOLIC EMANCIPATION**, the movement for the abolition of the penal laws against Catholics. (See ENGLISH HISTORY; IRELAND; ROMAN CATHOLIC CHURCH.)

**CATHOLIC UNIVERSITY OF AMERICA, THE**, an institution of higher education at Washington, D.C., founded at the third plenary council of Baltimore in 1884. The constitutions of the university were approved by Pope Leo XIII, and the graduate school of sacred sciences was opened Nov. 13, 1889. A school of philosophy and social sciences was inaugurated in 1895, followed by the school of law (1895) and the school of canon law (1923). A reorganization of the schools took place in 1930, when all courses in philosophy, letters and sciences, except technological, were grouped under the graduate school of arts and sciences and the college of arts and sciences. The technological courses were grouped under a school of engineering and architecture. Schools of social work, nursing education and social science were later added. In 1942 the university's teaching staff numbered 231. The enrolment was 2,027, of whom 1,029 were religious students and 998 lay students.

**CATILINE** (LUCIUS SERGIUS CATILINA) (c. 108–62 B.C.), a member of an ancient but impoverished patrician family of Rome. He was a supporter of Sulla, and during the proscription he was conspicuous for his greed and cruelty. He was guilty of at least one murder. In 77 he was a quaestor, in 68 praetor and in 67–66 governor of Africa. His impeachment for extortion having disqualified him as a candidate for the consulship, he formed a conspiracy, behind which, in all probability, were Crassus and Caesar. The new consuls were to be murdered on Jan. 1, but the plot—the execution of which was deferred till Feb. 5—failed. Soon after, Catiline was acquitted through bribery in the trial for extortion. His scheme widened. The city was to be fired; those who opposed the revolution were to be slain; all debts were to be cancelled; there was to be a proscription of wealthy citizens. Catiline intended to secure the consulship for 63 with C. Antonius as colleague, but Cicero got first place, and Catiline was defeated. C. Antonius, in whom Catiline hoped to find a supporter, was won over by his colleague Cicero. Before the next *comitia consularia* assembled, the orator had given so impressive a warning of impending danger that Catiline was once more rejected (63), and the consuls were invested with absolute authority. Catiline now resolved upon open war; preparations were set on foot throughout Italy, especially in Etruria, where revolt was raised by C. Manlius (or Mallius), one of Sulla's veterans. A plan to murder Cicero in his own house on the morning of Nov. 7 was frustrated. On the next day Cicero attacked Catiline so vigorously in the senate (in his first Catilinarian oration) that he fled to his army in Etruria. Next day Cicero awoke the terror of the people by a second oration delivered in the forum, in consequence of which Catiline and Manlius were declared public enemies, and the consul Antonius was despatched with an army against them. Meanwhile the conspirators in the city tried to induce some Gallic envoys who happened to be in Rome to join them. The plot was betrayed to Cicero, at whose instigation documentary evidence was obtained, implicating Lentulus and others. They were arrested, proved guilty and on Dec. 5 put to death in the underground dungeon on the slope of the Capitol. This act was afterwards attacked as a violation of the constitution, on the ground that the senate had no power of life and death over a Roman citizen. In the beginning of 62 Catiline saw his legions shut in

between those of Metellus Celer and C. Antonius. Near Pistoria he was completely defeated by Antonius, and himself fell in the battle. It must not be forgotten that our authorities for this conspiracy were all members of the aristocratic party. Some of the incidents given as facts by Dio Cassius are absurdities; and Cicero paid more regard to the effect than to the truthfulness of an accusation. We find him at one time seeking a political union with Catiline; at another, declaiming against him as a murderer and profligate. Lastly, though Sallust's vivid narrative is consistent throughout, it is obvious that he cherished very bitter feelings against the democratic party. Nevertheless, we cannot regard Catiline as an honest enemy of the oligarchy, or as a disinterested champion of the provincials.

See E. S. Beesley, *Catiline, Clodius and Tiberius* (1878); E. von Stern, *Catiline und die Parteikämpfe in Rom* 66–63 (1883); C. Thiaucourt, *Étude sur la conjuration de Catiline* (1887); J. E. Blondel, *Histoire économique de la conjuration de Catiline* (1893); Gaston Boissier, *La Conjuration de Catiline* (1905), and *Cicero and his Friends* (Eng. trans.); E. G. Hardy, "The Catilinarian Conspiracy—a re-study of the Evidence," *Journal of Roman Studies* (1917); W. H. Heitland, *The Roman Republic* (1923); T. Rice Holmes, *The Roman Republic* ch. IV., and part II. pp. 446–473 (1923); Tyrrell and Purser's ed. of Cicero's *Letters* (index vol. s.v. "Sergius Catilina").

**CATINAT, NICHOLAS** (1637–1712), marshal of France, was born on Sept. 1, 1637, in Paris, entered the Gardes Françaises at an early age, and distinguished himself at the siege of Lille in 1667. He served with great credit in the campaigns of 1676–78 in Flanders, was employed against the Vaudois in 1686, and after taking part in the siege of Philipsburg at the opening of the War of the League of Augsburg, he was appointed to command the French troops in the south-eastern theatre of war. In 1690 he conquered Savoy, and in 1691 Nice; the battle of Staffarda, won by him over the duke of Savoy in 1690, and that of Marsaglia in 1693, were among the greatest victories of the time. In 1696 Catinat forced the duke to make an alliance with France. He had in 1693 been made a marshal of France. At the beginning of the War of the Spanish Succession, Catinat was placed in charge of operations in Italy, but he was hampered by the orders of the court and the insufficiency of the forces for their task. He suffered a reverse at Carpi (1701) and was soon superseded by Villeroi, to whom he acted as second-in-command during the campaign of Chiari. He died at St. Gratien on Feb. 25, 1712.

**CATION**, a positively charged particle or ion which moves toward the negative electrode (cathode) during an electrolysis or an electrical discharge. The cation consists of a single atom or a group of atoms (radical) and bears a specific number of unit positive charges equal to its electrovalence. The silver ion ( $\text{Ag}^+$ ) and the ammonium ion ( $\text{NH}_4^+$ ) are both univalent cations while mercurous ion ( $\text{Hg}_2^{++}$ ) and cupric ion ( $\text{Cu}^{++}$ ) are bivalent cations. In solution the ion is usually in combination with a number of the solvent molecules. (See also ELECTRICITY: *Historical Introduction*; ELECTRICITY, CONDUCTION OF: *Conduction in Liquids*; ELECTROCHEMISTRY.) (J. B. Ps.)

**CATKIN** or **AMENTUM**, a pendulous spike of simple flowers separated by bracts, found in many trees, as, for example, willow and poplar.

(See FLOWER.)

**CATLETTSBURG**, a residential city of northeastern Kentucky, U.S., on the Ohio river at the mouth of the Big Sandy, where Ohio, West Virginia and Kentucky meet; the county seat of Boyd county. It is on federal highway 60 and the Chesapeake and Ohio railway.

The population in 1950 was 4,739; it was 4,524 in 1940 by the federal census.

Oil refining and chemicals are the principal industries.

**CATLIN, GEORGE** (1796–1872), American ethnologist, was born at Wilkes-Barre (Pa.), in 1796. He was educated as a lawyer and practised in Philadelphia for two years; but art was his favourite pursuit, and forsaking the law he established himself at New York as a portrait painter. In 1832, realizing that the American Indians were dying out, he resolved to rescue their types and customs from oblivion. With this object he spent many years among the Indians in North and South America. He lived with them, acquired their languages, and studied very thoroughly



their habits, customs and mode of life, making copious notes and many studies for paintings. In 1840 he came to Europe with his collection of paintings, most of which are now in the National museum, Washington, as the Catlin gallery; and in the following year he published the *Manners, Customs and Condition of the North American Indians* in two volumes, illustrated with 300 engravings. This was followed in 1844 by *The North American Portfolio*, containing 25 plates of hunting scenes and amusements in the Rocky mountains and the prairies of America, and in 1848 by *Eight Years' Travels and Residence in Europe*. In 1861 he published a curious little volume, in "manograph," entitled *The Breath of Life*, on the advantage of keeping one's mouth habitually closed, especially during sleep; and in 1868 *Last Rambles amongst the Indians of the Rocky Mountains and the Andes*. He died in Jersey city (N.J.), on Dec. 22, 1872.

See W. H. Miner, *George Catlin* with an annotated bibl. (1901), also *My Life Among the Indians* (ed. by N. G. Humphreys, 1909).

**CATO, DIONYSIUS**, the supposed author of the *Dionysii Catonis Disticha de Moribus ad Filium*. In the middle ages the author of the *Disticha* was supposed to be Cato the elder, who wrote a *Carmen de Moribus*, but extracts from this in Aulus Gellius show that it was in prose. Nothing is really known of the author or date of the *Disticha*; it can only be assigned to the 3rd or 4th century A.D. It is a small collection of moral apophthegms, monotheistic in character, not specially Christian. The book had a great reputation in the middle ages, and was translated into many languages; it is frequently referred to by Chaucer, and in 1483 a translation was issued from Caxton's press at Westminster.

See editions by F. Hauthal (1869), with full account of mss. and early editions, and G. Némethy (1895), with critical notes; Eng. trans. by Chase (Madison, 1922); see also F. Zarncke, *Der deutsche Cato* (1852), a history of middle age German translations; J. Nehab, *Der altenglische Cato* (1879); E. Bischoff, *Prolegomena zum sogenannten Dionysius Cato* (1893), in which the name is discussed; F. Plessis, *Poésie latine* (1909), 663; for mediaeval translations and editions see Teuffel, *Hist. of Roman Lit.* § 398, 3.

**CATO, MARCUS PORCIUS** (95-46 B.C.), Roman philosopher, called *Uticensis*. On the death of his parents he was brought up in the house of his uncle, M. Livius Drusus. After serving in the ranks against Spartacus (72 B.C.) he acted as military tribune (67) in Macedonia. On his return he became quaestor, and showed so much zeal and integrity in the management of the public accounts that he obtained a provincial appointment in Asia, where he strengthened his reputation. He admired the discipline which Lucullus had enforced in his own eastern command, and supported his claims to a triumph, while he opposed the pretensions of Pompey. As tribune in 62 he prosecuted L. Licinius Murena, consul-elect, for bribery. Cato supported Cicero at the time of the conspiracy of Catiline and voted for the execution of the conspirators, thus incurring the resentment of Julius Caesar, who did his utmost to save them.

Cato was now regarded as one of the leaders of the senatorial nobility. He vainly opposed Caesar's candidature for the consulship in 59, and his attempt, in conjunction with Bibulus, to prevent the passing of Caesar's agrarian law proved unsuccessful. Yet he was still an obstacle of sufficient importance for the triumvirs to desire to get rid of him. At the instigation of Caesar he was sent with a mission to settle the affairs of Cyprus (58). On his return two years later he continued to struggle against the combined powers of the triumvirs in the city, and became involved in scenes of violence and riot. He obtained the praetorship in 54, and endeavoured to suppress bribery, in which all parties were equally interested. He failed to attain the consulship, and had made up his mind to retire from public life when the civil war broke out in 49. He realized that the sole chance for the free state lay in supporting Pompey, whom he had formerly opposed. At the outset of the war he was entrusted with the defence of Sicily, but finding it impossible to hold the island he joined Pompey at Dyrrhachium. He was not present at the battle of Pharsalus, and after the battle, when Pompey abandoned his party, Cato led a small remnant of their forces into Africa. After his famous march through the Libyan deserts, he shut himself up

in Utica, and even after the decisive defeat at Thapsus (46), in spite of the wishes of his followers, he determined to keep the gates closed till he had sent off his adherents by sea. When the last of the transports had left the port he cheerfully dismissed his attendants, and soon afterwards stabbed himself.

He had been reading, we are told, in his last moments Plato's dialogue on the immortality of the soul, but his own philosophy had taught him to act upon a narrow sense of immediate duty without regard to the future. He conceived that he was placed in the world to play an active part, and when disabled from carrying out his principles, to retire gravely from it. He had lived for the free state, and it now seemed his duty to perish with it. In politics he was a typical doctrinaire, blind to the fact that his national ideal was an anachronism. The only composition by him which we possess is a letter to Cicero (*Ad. Fam.* xv. 5). The school of the Stoics, which took a leading part in the history of Rome under the earlier emperors, looked to him as its saint and patron. Immediately after his death Cato's character became the subject of discussion; Cicero's panegyric *Cato* was answered by Caesar in his *Anticato*. Brutus, dissatisfied with Cicero's work, produced another on the same subject; in Lucan Cato is represented as a model of virtue and disinterestedness.

See his *Life* by Plutarch; also C. W. Oman, *Seven Roman Statesmen of the Later Republic*, Cato . . . (1902); Mommsen, *Hist. of Rome* (Eng. trans.), bk. v. ch. v.; Gaston Boissier, *Cicero and his Friends* (Eng. trans., 1897); esp. pp. 277 foll.; Warde Fowler, *Social Life at Rome* (1909).

**CATO, MARCUS PORCIUS** (234-149 B.C.), Roman statesman, surnamed "The Censor" or "The Elder," was born at Tusculum of an ancient plebeian family. He was bred to agriculture, but, having attracted the notice of L. Valerius Flaccus, he was brought to Rome, and became successively quaestor (204), aedile (199), praetor (198), and consul (195). During his term of office he vainly opposed the repeal of the Lex Appia, to restrict extravagance on the part of women. Meanwhile he served in Africa, and took part in the campaign of Zama (202). He held a command in Sardinia and again in Spain, which he subdued with great cruelty, thereby gaining a triumph (194). In the year 191 he acted as military tribune in the war against Antiochus III. of Syria. If he was not personally engaged in the prosecution of the Scipios (Africanus and Asiaticus) for corruption, it was his spirit that animated the attack upon them. Cato's enmity dated from the African campaign when he quarrelled with Scipio for his lavish distribution of the spoil amongst the troops, and his general luxury and extravagance.

Cato opposed the spread of the new Hellenic culture which threatened to destroy ancient Roman simplicity. His purpose was shown most clearly in the discharge of the censorship; hence his title of "Censor." He revised with unsparing severity the lists of senators and knights, ejecting the men whom he judged unworthy, either on moral grounds or from want of means. The expulsion of L. Quinctius Flamininus for cruelty was an example of his rigid justice. His regulations against luxury were very stringent, and he supported the Lex Orchia (181) and Lex Voconia (169). He repaired the aqueducts, cleansed the sewers, prevented private persons drawing off public water for their own use, ordered the demolition of houses which encroached on the public way, and built the first basilica in the forum near the curia. He raised the amount paid by the publican for the right of farming the taxes, and at the same time diminished the contract prices for the construction of public works.

From the date of his censorship (184) to his death in 149, Cato held no public office, but continued to distinguish himself in the senate as the persistent opponent of the new ideas. Like many others he was shocked at the licence of the Bacchanalian mysteries; and he urged the dismissal of the philosophers (Carneades, Diogenes and Critolaus), who came as ambassadors from Athens, on account of the dangerous nature of their views. Almost his last public act was to urge his countrymen to the Third Punic War and the destruction of Carthage. In 157 he was one of the deputies sent to arbitrate between Carthage and Numidia and was so struck by Carthaginian prosperity that he was convinced that the security of Rome depended on the annihilation of Carthage.

From this time, in season and out of season, he kept repeating the cry: "Delenda est Carthago" ("Carthage must be destroyed").

Cato regarded the family as the germ of the State, and proved himself a hard husband, a strict father, a severe and cruel master. There was little difference apparently, in the esteem in which he held his wife and his slaves; his pride alone induced him to take a warmer interest in his sons. The Romans respected this behaviour as a traditional example of the old Roman manners (Livy xxxix. 40).

Cato was the first Latin prose writer of any importance, and the first author of a history of Rome in Latin. His treatise on agriculture (*De Agricultura* or *De Re Rustica*) is the only work by him that has been preserved. It contains a miscellaneous collection of rules of good husbandry, conveying much curious information on the domestic habits of the Romans of his age. His most important work *Origines*, in seven books, related the history of Rome from its earliest foundations to his own day. His speeches, of which 150 were collected, were chiefly directed against the young nobles of the day. He also wrote a set of maxims for the use of his son (*Præcepta ad Filium*) and some rules for everyday life in verse (*Carmen de Moribus*). The collection of proverbs in hexameter verse, extant under the name of Cato, probably belongs to the 4th century A.D. (See CATO, DRONYSIUS)

**BIBLIOGRAPHY.**—There are lives of Cato by Cornelius Nepos, Plutarch and Aurelius Victor, and many particulars of his career and character are to be gathered from Livy and Cicero. See also G. Kurth *Caton l'ancien* (Bruges, 1872); F. Marcucci *Studio critico sulle Opere di Catone il Maggiore* (1902). The best edition of the *De Agricultura* is by H. Keil (1884-91), of the fragments of the *Origines* by H. Peter (1883) in *Historicorum Romanorum Fragmenta*, of the fragments generally by H. Jordan (1860); see also J. Wordsworth *Fragmenta and Specimens of Early Latin* (1874); Mommsen *Hist. of Rome* (Eng. trans.) bk. iii. ch. xi. and xiv.; Warde Fowler *Social Life at Rome* (1909).

**CATO, PUBLIUS VALERIUS**, Roman poet and grammarian, was born about 100 B.C. He was the leader of the "new" school of poetry (*poetae novi*, as Cicero calls them). Its followers rejected the national epic and drama in favour of the artificial mythological epics and elegies of the Alexandrian school. The great influence of Cato is attested by the lines:—

Cato grammaticus, Latina Siren  
Qui solus legit ac facit poetas.<sup>1</sup>

Our information regarding his life is derived from Suetonius (*De Grammaticis*, 11). He was a native of Cisalpine Gaul, and lost his property during the Sullan disturbances before he had attained his majority. He lived to a great age and during the latter part of his life was very poor. In addition to grammatical treatises, Cato wrote a number of poems, the best known of which were the *Lydia* and *Diana*. In the *Indignatio* (perhaps a short poem) he defended himself against the accusation that he was of servile birth. It is probable that he is the Cato mentioned as a critic of Lucilius in the lines by an unknown author prefixed to Horace, *Satires*, i. 10.

Among the minor poems attributed to Virgil is one called *Dirae* (or rather two, *Dirae* and *Lydia*). The *Dirae* consists of imprecations against the estate of which the writer has been deprived, and where he is obliged to leave his beloved Lydia; in the *Lydia*, on the other hand, the estate is envied as the possessor of his charmer. Joseph Justus Scaliger was the first to attribute the poem (divided into two by F. Jacobs) to Valerius Cato, on the ground that he had lost an estate and had written a *Lydia*. The balance of opinion is in favour of the *Dirae* being assigned to the beginning of the Augustan age, although O. Ribbeck supports the claims of Cato to the authorship. The best edition of these poems is by A. F. Nägele (1847), with exhaustive commentary and excursuses; a clear account of the question will be found in M. Schanz's *Geschichte der römischen Literatur*; for the "new" school of poetry see Mommsen, *Hist. of Rome*, bk. v. ch. xii.; F. Plessis, *Poésie latine* (1909), 188.

**CATS, JAKOB** (1577-1660), Dutch poet and humorist, was born at Brouwershaven in Zeeland. He studied law at Leyden and at Orleans, and, returning to Holland, settled at The Hague, where he began to practise as an advocate. His pleading in defence of a wretched creature accused of witchcraft brought him many clients and some reputation. He had a serious love affair

<sup>1</sup>"Cato, the grammarian, the Latin siren, who alone reads aloud the works and makes the reputation of poets."

about this time, which was broken off on the very eve of marriage by his catching a tertian fever which defied all attempts at cure for some two years. For medical advice and change of air Cats went to England, where he consulted the highest authorities in vain. He returned to Zeeland to die, but was cured mysteriously by a strolling quack. He married in 1602 a lady of some property, Elisabeth von Valkenburg, and thenceforward lived at Grypskerke in Zeeland, where he devoted himself to farming and poetry. His best works are: *Emblemata* or *Minnebeelden* with *Maegdenplicht* (1618); *Spiegel van den ouden en nieuwen Tijd* (1627); *Houwelijck . . .* (1625); *Selfstrijt* (1620); *Ouderdom en Buytlenven op. Zorgh-Vliet* (1655); and *Gedachten op. slapelooze nachten* (1661). In 1621, on the expiration of the 12 years' truce with Spain, the breaking of the dykes drove him from his farm. He was made pensionary (stipendiary magistrate) of Middelburg; and two years afterwards of Dort. In 1627 Cats came to England on a mission to Charles I., who made him a knight. In 1636 he was made grand pensionary of Holland, and in 1648 keeper of the great seal; in 1651 he resigned his offices, but in 1657 he was sent a second time to England on what proved to be an unsuccessful mission to Cromwell. In the seclusion of his villa of Sorgvliet, near The Hague, he lived from this time till his death, occupied in the composition of his autobiography (*Eighty-two Years of My Life*, first printed at Leyden in 1734) and of his poems. He is still spoken of as "Father Cats" by his countrymen.

Cats was contemporary with Hooft and Vondel and other distinguished Dutch writers in the golden age of Dutch literature, but his Orangist and Calvinistic opinions separated him from the liberal school of Amsterdam poets. He was intimate with Constantijn Huygens, whose political opinions were more nearly in agreement with his own. For an estimate of his poetry see DUTCH LANGUAGE AND LITERATURE. Hardly known outside Holland, among his own people for nearly two centuries his work enjoyed an enormous popularity.

See G. Derudder, *Un poète néerlandais: Cats, sa vie, son oeuvre* (Calais, 1898); G. Kalf, *Jakob Cats* (1902).

**CAT'S-EYE**, a name given to several distinct minerals, their common characteristic being that when cut with a convex surface they display a luminous band, like that seen by reflection in the eye of a cat. (1) Precious, oriental or chrysoberyl cat's-eye. This, the rarest of all, is a chatoyant variety of chrysoberyl (*q.v.*), showing in the finest stones a very sharply defined line of light. (2) Quartz cat's-eye. This is the common form of cat's-eye, in which the effect is due to the inclusion of parallel fibres of asbestos. It is obtained chiefly from Ceylon, but, though coming from the east, it is often called "occidental cat's-eye"—a term intended simply to distinguish it from the finer oriental stone. It is readily distinguished by its inferior density, its specific gravity being only 2.65, while that of oriental cat's-eye is as high as 3.7. A greenish fibrous quartz, cut as cat's eye, occurs at Hof and some other localities in Bavaria. (3) Crocidolite cat's-eye, a beautiful golden brown mineral, with silky fibres, found in Griqualand West, and much used in recent years as an ornamental stone, sometimes under the name of "South African cat's-eye." It consists of fibrous quartz, coloured with oxide of iron, and results from the alteration of crocidolite (see ASBESTOS). (4) Corundum cat's-eye. In some asteriated corundum the star is imperfect and may be reduced to a luminous zone, producing an indistinct cat's-eye effect. (F. W. R.)

**CATSKILL**, a village of New York, U.S., on the west bank of the Hudson river, 35 mi. S. of Albany; the county seat of Greene county. It is on federal highway 9W, and is served by the West Shore branch of the New York Central railroad. Population (1950) 5,336; (1940) 5,429. Catskill is a summer resort, and is the gateway to the Catskill mountain region. Near by is the spot where Rip Van Winkle had his fabled sleep of 20 years. At Leeds, on the Mohican trail just northwest of the village, is a beautiful stone arch bridge of the 18th century. The bridge was reconstructed after an old design in 1939 by the highway department of the state. The first settler there was Derrick Teunis van Vechten, in 1680. The village was incorporated in 1806.

**CATSKILL MOUNTAINS**, a group of moderate elevation pertaining to the Allegheny plateau and not included in the Appalachian system because they lack the internal structure and general parallelism of topographic features which characterize the Appalachian ranges. They are situated mainly in Greene and Ulster counties in the state of New York, with minor sections extending into Delaware and Schoharie counties. The Catskills rise to about the general height of the Highlands of Scotland or the Harz mountains of Germany, the group containing many summits above 3,000 ft. elevation and half a dozen approaching 4,000, Slide mountain (4,204 ft.) and Hunter mountain (4,025 ft.) being the only ones exceeding that figure.

The Catskills were not subject to the general folding which marked the elevation of the main ridges of the Appalachians. This gives the mountains the features of a carved plateau with scenery of a subdued type. There are, however, a number of rugged precipices on their outer faces and a number of deeply worn gorges called "cloves." Stony clove and Kaaterskill clove are picturesque gorges, the latter containing three cascades having a total fall of about 300 ft. The Devassego falls of the Schoharie are also strikingly picturesque. Some of the views which have become noted for their magnificent panorama are Pine Orchard ledge, where there is an unobstructed view of the mountain region of Massachusetts, Vermont and New Hampshire; Kaaterskill knob, North Mountain outlook, Sunset rock, Prospect rock, and others. The mountains are, as a whole, well wooded quite up to their summits—pine, spruce, oak, hickory, beech, maple, rhododendron and mountain laurel being common. The almost total absence of lakes is remarkable.

**CATT, CARRIE LANE CHAPMAN** (1859-1947), U.S. leader in the woman suffrage and peace movements, was born in Ripon, Wis., Jan. 9, 1859. She graduated from Iowa State college, Ames, in 1880. She married first Leo Chapman (1884; d. 1886), then George W. Catt (1890; d. 1905). In 1890 she had her first suffrage campaign experience under Susan B. Anthony in South Dakota.

Mrs. Catt reorganized the National American Woman Suffrage association on political district lines, 1909-15, so that in working for the vote women were trained for political action; she marshalled these seasoned campaigners, 1915-20, on a national scale to influence congress to submit the 19th amendment enfranchising women, and the state legislatures to ratify it. After bitter opposition in the senate, congress submitted the amendment in 1919, and it was ratified Aug. 26, 1920. Mrs. Catt reorganized the suffrage association, then 2,000,000 strong, as the National League of Women Voters, 1919-20.

In 1902 she founded the International Woman Suffrage alliance, which held its first congress in Berlin, 1904, and was its president until she retired at the congress in Rome, 1923. In 1911-12, accompanied by Aletta Jacobs of the Netherlands, she made a pioneer feminist voyage around the world.

In 1925 she enlisted the co-operation of 11 national women's organizations in the National Committee on the Cause and Cure of War, to start a campaign of education for U.S. participation in world organization for peace. Following World War II, she was vitally interested in the success of the United Nations, using her influence to have qualified women on certain commissions. She died on March 9, 1947.

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**CATTANEO, CARLO** (1801-1869), Italian philosopher and republican, was the founder of the review *Il Politecnico*. He was the heart and soul of the Five Days of Milan (March 18-22, 1848), and bitterly opposed the hegemony of Piedmont in Italy. On the return of the Austrians he fled to Lugano, and there he wrote his *Storia della rivoluzione del 1848* and the *Archivio triennale delle cose d'Italia* (3 vol., 1850-55). An uncompromising opponent of Cavour, he steadfastly refused to stand for election to the Italian parliament owing to his inability to take the oath of allegiance to the monarchy.

See his *Opere edite ed inedite*, ed. by A. Bertani, 7 vol. (Florence,

1881-92), *Scritti politici ed epistolari*, ed. by G. Rosa and J. W. Mario (Florence, 1892) and *Scritti storici, letterari, etc.*, ed. by C. Romussi (Milan, 1898). See also A. and J. Mario, *Carlo Cattaneo* (Florence, 1884); E. Zanoni, *Carlo Cattaneo nella vita e nelle opere* (1898); G. Nelli, *La Filosofia di Carlo Cattaneo* (Crema, 1901); G. Salvemini, *Le più belle pagine di Carlo Cattaneo* (Milan, 1922).

**CATTANEO, DANESE DI MICHELE** (1509-1573), Italian sculptor, born at Colonnata, near Carrara, pupil of Jacopo Sansovino in Rome. It is said he was taken prisoner three times by the Imperialists during the "Sacco di Roma" in 1527. He fled to Florence, where he carved the marble bust of Alessandro de' Medici; and then joined Sansovino in Venice. He was employed by his master on sculptures for the Libreria di San Marco and the Zecca. Among his works in Venice are the "Apollo" crowning the fountain in the Zecca; the "St. Jerome" in San Salvatore, the figures on the tombs of Leon Loredano in SS. Giovanni e Paolo, and of Andrea Badoer in the Scuola di S. Giovanni Battista. He also worked in Padua for the church of Sant' Antonio. The fine bust of Pietro Cardinal Bembo (1547) placed on the tomb in that church is by his hand. At Verona he built the tomb of Gian Fregoso in S. Anastasia with the help of his distinguished pupil Gerolamo Campagna. He returned to Padua in 1572, but death cut short his work on the reliefs for the Capella del Santo, which were completed by Campagna. Cattaneo was also a poet; his poems *Dell'amor di Marfisa* (1562) were praised by Torquato Tasso. His grandson Niccolo collected his writings.

**CATTARO** (Serbo-Croatian *Kotor*), a seaport of the former kingdom of Montenegro, Yugoslavia. Pop. (1931) 5,011. The town, which is Venetian in appearance, occupies a ledge between the Montenegrin mountains and the Bocche di Cattaro, a beautiful inlet of the Adriatic, which expands into five broad gulfs united by narrower channels, and forms one of the finest natural harbours in the world.

Cattaro is strongly fortified; on the seaward side Castelnovo (Serbo-Croatian, *Erceg-novi*) guards the main entrance to the Bocche; on the landward side, long walls run from the town to the castle of San Giovanni far above, while the barren heights of the Krivosie, toward Montenegro, are crowned by small forts.

Cattaro is a Yugoslav city, divided almost equally between the Roman Catholic and the Orthodox creeds. It is the seat of a Roman Catholic bishop with a cathedral containing some beautiful marble sculptures, a collegiate church and several convents. There is a secondary school, a naval college, an interesting naval museum, and a forest school. Cattaro is famous for its lacemaking, and also does an extensive trade in cheese. It is the chief port for Montenegro and Cetinje. Castelnovo, a picturesque town, rose around the citadel built in 1377 by a Bosnian king.

It has at various times been occupied by Turks, Venetians, Spaniards, Russians, French, English and Austrians. The Orthodox convent of St. Sava, standing amid beautiful gardens, was founded in the 16th century and contains many fine specimens of 17th-century silversmiths' work.

Rhizon, the modern port of Risano, from which a track leads into Montenegro, was a thriving "Illyrian" city as early as 229 B.C., and gave its name to the Bocche, then known as Rhizonicus Sinus. Rhizon submitted to Rome in 168 B.C. and about the same time Ascrivium, or Ascrvium, the modern Cattaro, is first mentioned as a neighbouring city. Justinian built a fortress above Ascrivium in A.D. 535, after expelling the Goths, and a second town probably grew up on the heights around it. The city was plundered by the Saracens in 840 and by the Bulgarians in 1102. In the next year it was ceded to Serbia by the Bulgarian tsar Samuel, but revolted, and only submitted in 1184 as a protected state. It was already an episcopal see, and in the 13th century Dominican and Franciscan monasteries were established to check the spread of Bogomilism. In the 14th century it was one of the capitals of the Serbian state of Dioklitya, and Stephen Dushan (1331-55) had his mint there, while its commerce, rivalling that of Ragusa, provoked the jealousy of Venice. After the downfall of Serbia in 1389, it was seized and abandoned by Venice and Hungary in turn, and finally passed under Venetian rule in 1420. It was besieged by the Turks in 1538 and 1657, visited by plague in 1672, and nearly destroyed by earthquakes in 1563 and 1667. In

1707 it passed to Austria; in 1805 it was assigned to Italy; in 1806 the Russians occupied it and Napoleon, to whom it had been ceded, took Ragusa in its stead. From 1807-13 it was united to the French empire; in the latter year, the Montenegrins aided by the British fleet held it for 5 months, and in 1814 it was restored by the Congress of Vienna to Austria, with whom it remained until 1918. During World War I the Montenegrins arrived before Cattaro, which was a centre of submarine activity. The Slav sailors mutinied in 1918 and many of them were shot or imprisoned. In 1918 it became part of Yugoslavia, but it was occupied in 1941 by Italy.

See G. Gelcich (Gelčić), *Memorie storiche sulle Bocche di Cattaro* (Zara, 1880).

**CATTEGAT** or **KATTEGAT** (Scand. "cat's-throat"), a strait forming part of the connection between the Baltic and the North seas. It lies north and south between Sweden and Denmark, and connects north with the Skaggerak and south through the Sound, Great Belt and Little Belt with the Baltic sea. Length about 150 mi., extreme breadth about 88 mi., area 9,840 sq.mi., mean depth not more than about 14 fathoms. (See BALTIC SEA.)

**CATTELL, JAMES MCKEEN** (1860-1944), U.S. psychologist and editor, born at Easton, Pa., May 25, 1860, A.B. Lafayette, 1880, Ph.D. Leipzig, 1886, is known for his researches and for the organization of co-operation in science. After lectureships at Pennsylvania, Bryn Mawr and Cambridge universities, he was professor of psychology at Pennsylvania, 1888-91, the first chair in psychology. He was professor at Columbia, 1891-1917. In 1929 he was elected president of the International Congress of Psychology. With James M. Baldwin, Cattell was editor of the *Psychological Review*, 1894-1904. He reorganized *Science* in 1894 and in 1900 it became the organ of the American Association for the Advancement of Science. In 1900 he took over *Popular Science Monthly*, later the *Science Monthly*. He also edited the *American Naturalist* and *School and Society*, 1915-39. Cattell was always interested in men of science and, in part as a tool in the study of development in science, he published (1906-39) *American Men of Science*. He organized the Psychological corporation in 1921 to promote psychological aid to industry and was long its president. Cattell died Jan. 20, 1944. (W. B. PY.)

**CATTERMOLE, GEORGE** (1800-1868), English painter, chiefly in water colours, was born at Dickleburgh, near Diss, Norfolk, in August 1800. At the age of 16 he began working as an architectural and topographical draughtsman. Cattermole was a painter of no inconsiderable gifts, with great facility in picturesque resource. He was also a book illustrator. At the Paris exhibition of 1855 he received one of the five first-class gold medals awarded to British painters. He died on July 24, 1868. Among his leading works are "The Murder of the Bishop of Liège" (15th century), "The Armourer Relating the Story of the Sword," "The Assassination of the Regent Murray by Hamilton of Bothwellhaugh," and (in oil) "A Terrible Secret."

**CATTLE.** The word "cattle," which etymologically merely denotes a form of property and is practically synonymous with "chattel," is by common usage a generic term for animals of the bovine race. The several animals that may be included under the term are usually divided into the following six groups: (1) buffaloes (India, Africa, etc.); (2) bison (Europe and North America); (3) the yak (Tibet, etc.); (4) the gaur, gayal and bantian (India and further India); (5) eastern and African domesticated cattle or zebu; and (6) western or European domesticated cattle. In addition to the two last-mentioned groups the India buffalo, yak, gayal and bantian have been domesticated. Apart from the buffaloes, which constitute a relatively primitive and rather distinct type, all the species enumerated are rather closely related. The buffaloes do not hybridize with the members of the other groups, but all the rest can be interbred without difficulty and the hybrids, or at least the female hybrids, are quite fertile. (See also AUROCHS; BANTIN; BISON; BOVIDAE; BUFFALO; GAUR; GAYAL; OX; YAK.)

The ox was one of the earliest of all animals to be domesticated for agricultural purposes. In western Europe there is no evidence of domestication in Palaeolithic times but there are

plentiful remains in the Swiss lake dwellings and other deposits of Neolithic age. Domesticated cattle existed in Egypt about 3500 B.C., and possibly much earlier, while Babylonian remains have been assigned to still more remote ages.

In all likelihood the wild ancestors of European domesticated cattle belonged to one or more of the sub-species of the auroch or urus (*Bos primigenius*) which were widely distributed in Europe, western Asia and northern Africa in prehistoric times. However, the earliest known domesticated ox in Europe was a very small, slenderly built animal, with short horns, bearing all the marks of a prolonged existence under the care of man and contrasting very markedly with the contemporary wild urus. The conclusion has been drawn that the original domestication did not occur in western Europe; probably the little ox (*Bos longifrons* or *Bos brachyceros*), together with corresponding types of sheep and pig, was brought from Asia by Neolithic man in his migrations. Later, in the Bronze age particularly, a new and larger type of cattle, showing a closer resemblance to the European wild ox, made its appearance. Probably the *Bos longifrons* had been "graded up" by crossing with the wild type. The process was, however, not universal, and even today breeds like the Shetland, Jersey, Kerry and Brown Swiss show a marked resemblance to the Neolithic type.

Whether the zebu had a separate origin from the western ox is not known; some authorities seek to relate it with the bantian or gayal. In shape, colour, habits and even in voice, it presents many points of difference from western cattle; but the most striking of these, such as the presence of a hump, or the upward inclination of the horns, are not constant. There exist in Africa, Spain, China, etc., breeds which are intermediate between zebu and European cattle, but it is likely that some, at least, of these have arisen from crossing. The economic value of cattle arose from the docility of the males for draught and the aptitude of the females for supplying milk in excess of the requirements of their offspring. Ultimately they were utilized as food but this was in a sense secondary, and among some races their flesh was regarded, for religious or other reasons, as unfit for human consumption. The breeding and rearing of cattle for the primary purpose of supplying meat is a modern development.

**Terminology.**—In the terminology used to describe the sex and age of cattle, the male is first a "bull-calf" and if left intact becomes a "bull"; but if castrated he becomes a "steer" and in about two or three years grows to an "ox." The female is first a "heifer-calf," growing into a "heifer" and becoming after two or three years a "cow." A heifer is sometimes operated on to prevent breeding and is then a "spayed heifer." The age at which a steer becomes an ox and a heifer a cow is not clearly defined and the practice varies. Both in the male and female emasculation is practised because the animals are assumed to fatten more readily; in the case of bulls intended for use as working oxen the object of emasculation, as in the case of stallions, is to make them quieter and more tractable in work.

#### BREEDS

The exact definition of a "breed" of cattle is difficult, although the term is commonly used and in practice well understood. It may be said generally to connote a particular type of animal which has for a long period been bred only with those of the same, or closely similar, type, and has hereditary characteristics which are transmissible to its offspring. In every breed, however long established, instances of atavism may and do occur, but these are eliminated and do not affect its general purity. Breeds have been established by generations of cattle breeders aiming at the attainment and preservation of a particular type and working on the principle that "like begets like." It is only within very recent times that the laws of heredity founded on the researches of Mendel have been studied as a science. There are many old-established breeds on the continent as for example the Charolais and Normande of France, the Holsteins of Holland, the Campagna di Roma of Spain, and many others, but the British breeds are of particular interest because of their influence in building up the vast herds which furnish the supplies of beef on which other countries are largely dependent. (See BEEF.)



**Beef Breeds.—The Shorthorn.**—The Shorthorn is an example of improvement of beef cattle by selection within a breed. In the last quarter of the 18th century two brothers, Charles and Robert Colling, farming in Durham county, England, began to improve the local cattle of the Teeswater district of that county. Their efforts were supplemented by other constructive breeders, notably Thomas Bates and Thomas Booth in Yorkshire. As many cattle of this breed have been exported to other countries from Durham, they are often called by that name.

Shorthorns are distinguishable from other breeds by their colour markings. They may be solid red, red with white markings, white or roan. Roan colour is a mixture of red and white hairs. The Shorthorn is the only modern breed that has a roan colour, making this colouring an index of Shorthorn breeding. Colour, scale and blocky conformation are characteristics of the breed.

Shorthorns are to be found in practically every country of the world. They are numerous in North America, in South America, particularly in Argentina, in Europe, being the most popular breed in the British Isles, and are bred to some extent on the continent; in Australia they have long met with favour and have also been bred quite extensively in South Africa. In the United States, Shorthorns are most numerous in the corn belt states and have been used rather extensively in other areas for grading up native or scrub cattle.

The *Shorthorn Herdbook*, the first of its kind for cattle, was begun in 1822 by George Coates. It was published as a private compilation until 1876 when it was taken over by the Shorthorn society. The first U.S. *Shorthorn Herdbook*, which registers all types of Shorthorns except the Milking type in the United States, was published in 1846 and in 1867 the first Canadian *Shorthorn Herdbook* was begun.

Strains of Shorthorns have been selected for milk and butterfat production, as well as beef, and in the United States are called Milking Shorthorns; in Canada, Dual-Purpose Shorthorns; in England and Australia, Dairy Shorthorns. In England many herds of Shorthorn cattle still show the beef and milk combination developed by the early improvers of the breed. In the United States throughout large areas in the middle west as well as in parts of the New England states, Milking Shorthorns are popular.

The Polled Shorthorn, as the name implies, is a strain within the breed possessing all of the Shorthorn characteristics except horns. This strain of polled cattle was developed in the United States in the late 1880s and early 1890s through the use of naturally hornless registered Shorthorns found within the breed. While beef characteristics have been emphasized, many good milkers have been developed among Polled Shorthorns.

Lincolnshire Red Shorthorns are a specialized type of the original Shorthorn stock.

**The Hereford.**—The Hereford is the product of generations of intelligent breeding work on the part of landed proprietors and tenant farmers of the fertile valleys in the county of Hereford, England. The origin of the breed has been lost in obscurity but it is thought to have descended from the primitive cattle of the country. Herefordshire is noted for its luxuriant grasses, and in this district, for many generations, the Hereford was bred for beef and draught purposes. The characteristic colour, red with white face and white markings, has been fixed for only a comparatively short time. When the first herdbook was published in 1846, the editor grouped the breed into four classes: mottle faced; light gray; dark gray; and red with white faces. Twenty-five years later all the colours but the last had practically disappeared. The outstanding characteristics of the breed are uniformity of colour, early maturity and ability to thrive under adverse conditions.

Herefords were first introduced into the United States in 1817 by Henry Clay, who imported a young bull, a cow and a heifer to his home in Kentucky. In 1860 Herefords were introduced into Canada by F. W. Stone of Guelph, Ontario. In the range areas of North America, it has become the predominating breed from Canada on the north, to Mexico on the south. In Great Britain it is chiefly bred in Herefordshire and vicinity although herds of this breed are found in Scotland, Ireland and Wales. The Hereford has met with much success also under range condi-

tions of Australia, New Zealand, Argentina, Uruguay and southern Brazil.

The first *Hereford Herdbook*, published in 1846 as a private enterprise, was taken over by the Hereford Cattle Breeders' Association of England in 1884. The American Hereford Cattle Breeders' association was organized in 1881, and in 1934 the official name was changed to American Hereford association.

In the United States there has been developed within the Hereford breed a strain without horns. This strain was developed by Warren Gammon of Iowa by selecting naturally hornless registered Herefords that differed from the standard Hereford only in the polled character. The number of Polled Herefords has increased very rapidly and herds are to be found throughout the United States. Polled Herefords have been exported to Canada, Mexico, South America, Hawaii, the Philippines and Australia. The American Polled Hereford Breeders' association is the national organization in the United States.

**The Aberdeen Angus.**—This breed of black, polled beef cattle, commonly called "doddies," originated in the county of Aberdeen, in Scotland. Its ancestry is obscure. The breed was improved and the present type of the cattle fixed early in the 19th century by a number of constructive breeders among whom Hugh Watson and William McCombie were the most famous.

The characteristic features of the breed are black colour, polled head, compact and low-set body, fine quality of flesh and high dressing percentage. The Aberdeen Angus is a beef breed of the highest rank and for years purebred or crossbred Angus steers have held high places of honour at the leading fat stock shows in Great Britain and in the United States. This breed was introduced into the United States in 1873 and after that date its influence spread widely in that and other countries. The first *Polled Herdbook* of Aberdeen Angus cattle was issued in Scotland in 1862. The American Aberdeen Angus Breeders' association was organized in 1883.

**The Devon.**—Devons are assumed to have descended from the smaller type of aboriginal cattle of Britain. Their neat, compact, symmetrical form and deep red colour—"rubies" as they are often called—make an attractive appearance in their native home in the hills of north Devon. For centuries they were bred primarily for draught purposes but early in the 19th century Francis Quartly, a north Devon breeder, is credited with having improved the breed for beef production. His herd became the chief source of supply of stock bulls for the entire district. John Tanner Davy continued the work of improvement and numerous famous Devons descended from his herd. A grandson, Colonel Davy, founded the *Devon Herdbook* in 1851 and brought the merits of the breed to the attention of other breeders. The first authentic record of registered Devons in America was a present of seven head of registered cattle of this breed sent to Robert Patterson of Baltimore by Thomas William Coke (later Earl of Leicester) of Holkham, England. Most of the early Devons in America descended from this shipment in 1817 and later shipments to the Patterson family. Because of its adaptability and hardiness the Devon breed has found favour in many other parts of the world—in New South Wales, South Africa, southern Brazil, Uruguay and the West Indies. The greatest number of Devons in the United States are found in New England.

In south Devon where the breed is also known as South Hams, the cattle are lighter coloured, larger, less active and also less symmetrical in conformation than the cattle of hilly north Devon. The South Devon is bred primarily for dairy purposes, producing a plentiful supply of milk of high quality, from which the well-known Devonshire cream is obtained.

**The Galloway.**—The beginnings of this breed of polled black cattle originating in Scotland are as obscure as the Aberdeen Angus. Although its native home is the ancient province or kingdom of Galloway in southwestern Scotland, it probably had a common origin with the Aberdeen Angus. The two breeds have much in common but the Galloway is to be distinguished from the Angus by its coat of curly black hair. The breed has never attained the prominence of other beef breeds but has been used quite extensively in producing "blue-gray" crossbred cattle,

obtained by breeding white Shorthorn bulls to Galloway cows. The resulting crossbred animals produce unsurpassed and extremely popular beef carcasses. Organized effort to promote Galloway cattle first took place in 1862 in Scotland when the *Polled Herdbook* was begun. The first four volumes of this book included both Galloway and Aberdeen Angus cattle. In 1877 an independent Galloway Cattle society was formed which has been in existence ever since. The American Galloway Breeders' association was organized in 1882.

*The Highland or West Highland.*—The native home of this breed of cattle, sometimes called "Kyloes," is the upland region of western Scotland. Little is known of their early history though it is generally believed they are the aboriginal cattle in that district. A typical West Highland animal with wide spreading horns, long shaggy coat, sturdy frame, thick mane and heavy dewlap makes an impressive picture. The colour is variable, being yellow, red, black, brindle and a mixture of red and black with a tawny red predominating. No other breed of British ancestry equals the West Highland for hardiness and ability to thrive on scanty pasturage. Cattle of this breed are comparatively small and slow in maturing, but they make beef of fine grain and unsurpassed flavour. The breed is not distributed widely outside its native home although some exportations have been made to other countries.

*The Longhorn.*—The Longhorn breed of Britain is to be distinguished from longhorn cattle that were once numerous in the western range area of the United States. The latter were descended from cattle brought to America by the Spaniards and are now practically extinct. But a common characteristic of both is the excessive horn growth from which the name is derived. In England the Longhorn has been improved by selective mating. Shorthorns have largely displaced these cattle in almost every district, but a number of herds are still in existence.

*The Sussex.*—The Sussex breed, found in Sussex, Kent, Surrey and Hampshire, is descended from the original stock of the country and has probably undergone little change in outward appearance since the middle ages. The district in which it is bred has large areas of stiff, heavy soils, calling for great strength at the plow, a requirement for which oxen of this breed are admirably suited. The Sussex is a heavy muscular animal, dark red in colour and is valued as a good grazer where beef rather than milk is sought. It has not attained wide distribution and even in England is not widely bred outside of its own county.

*The Red Poll.*—The Red Poll breed represents a blending of the cattle which were common in Norfolk and Suffolk counties, England, for centuries. The horned, red, hardy Norfolk cattle were noted for their fleshing qualities while the larger-framed, hornless Suffolks were exceptionally good milkers. The merging of these two bloodlines about 1846 provided the foundation for the present breed. The aim of breeders has been to produce medium-sized, hardy, hornless cattle, red in colour, smooth and compact, and equally good as producers of beef and milk. The usefulness of the breed is now well known the world over. Exportations have been made to the United States, Canada, South Africa, Australia, New Zealand and South and Central America.

*The Welsh.*—The Welsh breed is black with fairly long horns. Until the beginning of the 20th century there were two types known as North and South Welsh, but they were amalgamated in 1904 when the Welsh Black Cattle society was formed and a common herdbook established. The cattle mature rather slowly but grow to a large size and furnish beef of high quality.

*The Africander.*—The Africander is widely distributed throughout the Union of South Africa. Although the origin of the breed is not definitely known, it probably goes back to the Indian (*Bos indicus*) species and not to European (*Bos taurus*) cattle. The foundation of the breed was laid by the voortrekkers who valued their oxen above all other farm possessions. Before and after the Great Trek (1836) there existed a friendly rivalry among the farmers of South Africa to possess oxen that were uniform in conformation, shape of horns and colour markings, and that had hard, flinty feet and the straight easy action so desirable for trekking long distances.

The Africander has a hump over and slightly in front of the shoulders. This hump is more rounded, and blends more smoothly into the shoulder than that of zebu cattle. The colour may vary from dark to light red but dark red is preferred. After the days of the voortrekkers little attention was given to the development of milk production, but the Africander cow seldom fails to supply enough milk for her calf under the most adverse conditions. While the breed was developed primarily to produce trek oxen that would subsist entirely on the veld and survive droughts, later requirements have been for an early maturing, uniformly fleshed beef animal that maintains the hardiness of the earlier type. The Africander Cattle Breeders' society was formed in 1912 for the regulation and control of registrations of Africander cattle in the South African *Studbook*.

The first and only importation of Africander cattle into the United States was made in 1931 by the estate of Henrietta M. King (King ranch), Kingsville, Tex. The shipment consisted of 16 bulls and 13 cows and heifers.

*Brahman (Zebu) Cattle.*—The term Brahman has been selected by the United States department of agriculture as the name of all breeds of Indian cattle in the United States. In South America and in Europe these cattle are known as Zebus. Brahman cattle are characterized by a prominent hump above the shoulders, and an extreme development of loose, pendulous skin under the throat, on the dewlap, navel and the sheath of males. The rump is drooping. The head is long and narrow, ears are long and carried in a drooping manner, and horns differ widely according to sex and strain. The colour varies from shades of gray to black. Indian cattle, like those of Europe, vary in size, form and symmetry under the influence of local differences in climate, soil and available feed. In their native home, Indian cattle are used primarily for work and milk production. The vast majority of people of India are averse to killing them for food. Humped cattle of India were imported into the United States as early as 1849, but the importations that had the widest influence were made in 1906 and in 1924. These cattle were used in the gulf coast area of the United States for crossing with the improved breeds of beef cattle to produce a type adapted to the hot, humid conditions prevailing in that region.

*The Santa Gertrudis.*—This breed of cattle had its origin in the United States, having been developed by the King ranch in the state of Texas. It resulted from crossing Brahman bulls of about seven-eighths pure breeding, and purebred Shorthorn cows. Over a period of years, beginning in 1920, selective breeding was practised in which preference was given to red colour without sacrificing type and conformation. Santa Gertrudis cattle are, for the most part, solid red in colour with occasional small white markings, usually on the forehead or in the region of the flanks. They possess a slightly higher percentage of Shorthorn breeding than of Brahman.

The breed is named for one of the bulls that contributed much to its development. Santa Gertrudis cattle are the heaviest of the beef breeds when raised under similar conditions. They have great depth and length of body, with more loose skin about the neck, brisket and navel than the breeds of strictly British origin. They have proved to be highly adaptable to the gulf coast country where conditions are semitropical.

*Dairy Breeds.*—*The Holstein-Friesian.*—The Holstein-Friesian breed of cattle originated in north Holland and Friesland. Its chief characteristics are large size and black and white spotted markings, sharply defined rather than blended. These cattle are believed to have been selected for dairy qualities for about 2,000 years. They have long been widely distributed over the more fertile lowlands of continental Europe where they are valued highly for their milk-producing ability. However the milk has a relatively low butterfat content. When the Dutch colonized New York, they brought their cattle with them, but after the colony was ceded to the British crown and English settlers brought their own cattle, the Dutch cattle disappeared. The first exportation from Holland to the United States was in 1795, but the largest importations were made between the years 1879 and 1887. These cattle were registered in the *Holstein Herdbook* and the *Dutch*

*Friesian Herdbook.* In 1885 the two associations united in the Holstein-Friesian Association of America, the largest dairy breed association in the United States.

The breed is widely distributed although not so well adapted to rough, poor lands as some dairy breeds. Besides being well established in the lowland countries of western Europe in England, and throughout the United States, cattle of this breed are found in Canada, Australia, South America and South Africa.

*The Jersey.*—Within sight of the coast of Normandy in the English channel is a group of four small islands that have long been noted as the native home of two distinct breeds of dairy cattle—the Jersey and Guernsey. The Island of Jersey, the largest of the group, has an extremely mild climate and cattle can be outdoors most of the year. It is believed that the Jersey is descended from French cattle. Its colour is usually a shade of fawn or cream but darker shades are common. The fawn or cream has been attributed to the cattle of Normandy and the darker colour to those of Brittany. Jersey cattle are relatively small in size. The purity of the breed was recognized as early as in 1763, and in 1789 a law was passed prohibiting the importation of cattle into Jersey except for immediate slaughter. They have been introduced in large numbers into England, one of the earliest herds being formed in 1811. The first exportation to the United States was in 1850. The Jersey is adaptable to a wide range of conditions and its distribution is world-wide. Jersey milk is remarkably rich in butterfat, and for that reason animals of this breed are in demand for crossing with native stock to improve the quality of milk. The Royal Jersey Agricultural society, founded in 1833, assumed supervision of the breed on the Island of Jersey, while the English Jersey Cattle society, organized in the 1870s, became the registry association in Great Britain. The American Jersey Cattle club was organized in 1868, and under the supervision of this organization a register-of-merit system was established in 1903.

*The Guernsey.*—The Island of Guernsey, another of the Channel Islands, is the home of the Guernsey breed. Like the Jersey, this breed is thought to have descended from the cattle of near-by Normandy and Brittany. All of the cattle of the Channel Islands were at one time known as Alderneys. After laws had been enacted prohibiting the importation of cattle to the islands except for slaughter, the two distinct breeds—Jerseys and Guernseys—came to be recognized. Guernsey cattle are fawn coloured, marked with white, and are larger than their widely distributed sister breed, the Jersey. Guernseys are noted for the production of milk of a pronounced yellow colour. The first Guernseys were exported to the United States in 1830, but it was not until 1870 that the export business became extensive. Numbers of Guernsey cattle are to be found also in England, Australia and Canada. The Royal Guernsey Agricultural and Horticultural society supervises the breed on the Island of Guernsey, maintaining two herdbooks, one for general registration and the other for advanced registry. The American Guernsey Cattle club was organized in 1877 and supervises the advanced registry system and pedigree registration of Guernseys in the United States.

*The Brown Swiss.*—The native home of the Brown Swiss is Switzerland. The breed is probably one of the oldest in existence. While these cattle are classified as a dairy breed in the United States, they are often considered as a dual-purpose breed for they are heavier boned and thicker fleshed than the cattle of the Channel Islands breeds. The colour of the Brown Swiss varies from light brown or gray to a dark shade of these colours. Brown Swiss cows are good, persistent milkers, producing milk of average quality as compared with other breeds of dairy cattle.

This breed has found favour in Italy, Austria, Hungary, United States, Mexico and the South American countries. Brown Swiss were first introduced into the United States in 1869. The Brown Swiss Cattle Breeders' Association of America, organized in 1880, supervises the registration of pedigrees and the register of production of Brown Swiss cattle in the United States.

*The Ayrshire.*—The Ayrshire breed originated in the county of Ayr in southwestern Scotland in the latter part of the 18th century and is considered to be the only special dairy breed to have

originated in the British Isles. Native cattle of the county from which the breed takes its name appear to have been improved by crossing with other breeds to develop a type that would meet local conditions. Further mating and selection moulded the breed into its present form. The Ayrshire has very distinctive horns, which are long and curve outward, upward and slightly backward. The body colour varies from almost pure white to nearly all cherry red or brown with any combination of colours. The beef qualities of the breed are of secondary importance but among dairy breeds the Ayrshire ranks high as a beef producer. The distribution of the Ayrshire is wide, and exportations have been made to many countries. The breed is strongly represented in Canada and the northeastern part of the United States and is found also on the continent of Europe, in South Africa, Australia, New Zealand, Puerto Rico, Mexico and Central America. The Ayrshire Breeders' Association of the United States of America has been instrumental in fostering herd testing and a system of selective registration for approved sires of the breed.

**BIBLIOGRAPHY.**—U.S. Department of Agriculture, *B.A.I. Twenty Seventh Annual Report* (1910); C. S. Plumb, *Types and Breeds of Farm Animals*, rev. ed. (1920); C. H. Eckles, *Dairy Cattle and Milk Production*, rev. by E. L. Anthony and L. S. Palmer (1942); A. H. Sanders, *The Cattle of the World, Their Place in the Human Scheme—Wild Types and Modern Breeds in Many Lands* (1926); *Shorthorn Cattle* (1918), *The Story of the Herefords* (1914); A. M. Bosman, *Cattle Farming in South Africa* (1932); W. H. Peters, *Livestock Production* (1942); M. Clawson, *Western Range Livestock Industry* (1950).

**Pedigree Cattle Breeding.**—Many breeds and subbreeds of cattle are distributed throughout the world. On the continent of Europe alone, between 40 and 50 distinct breeds are described by French and German writers. Great Britain is the home of 11 breeds which have been exported to the United States, and in addition as many more minor breeds of local importance are described by English writers. The art of breeding seems to have begun in England about 1770 as the result of the work of Robert Bakewell. Bakewell was not only a pioneer breeder but is reported to have kept records and notes on the progeny of his cattle in order to show the progress made. The activities of the Collings brothers in improving the Shorthorn breed rank next to those of Bakewell in livestock improvement. The work begun by these breeders spread over Great Britain and had a lasting influence on livestock improvement throughout the civilized world. As the fame of British cattle spread to other countries, a demand was created for these improved breeds. Cattle were exported to other countries to found new herds and to improve the native cattle. Practically all present-day pure breeds of farm animals became breeds before the practice of registration, issuing of pedigrees and publication of their respective herdbooks was begun.

The development of breed registry associations in the United States differs somewhat from that of Great Britain where herdbooks remained open, for a time at least, to all animals that met certain requirements as to breed characteristics. The British practice tended to broaden the base of the breed. Cattle breeders continue to direct their efforts toward further improvement of breeds. Individual excellence and pedigree are accepted as only a part of breed improvement, as the essential test of an animal's breeding ability is in the performance of its progeny. Non-selective testing and the use of progeny-tested animals for breed improvement have received increasing attention by constructive breeders. The herd test and advanced register, or record-of-merit testing introduced by breeders of dairy cattle, the get-of-sire class, and slaughter test of the progeny of beef breeds are all useful tools in determining the utility value of registered cattle.

Conflicts of opinion on the use of impartial ratings with pedigrees are usually based on whether the information gained by such measures has enough practical usefulness to be worth the cost. Animal breeding is still practised largely as an art, with greater emphasis placed on selection by observation than on any other procedure. The setting up of well-defined types by early breeders, followed by rigid selection of breeding stock, was the basis of present breeds. Most of the subsequent improvement in the common livestock of the world has been accomplished by the mating of purebred sires to common females. Even in this



procedure best results are obtained when the females are selected with care and a high-quality registered sire is used. The effectiveness of this system of breeding is shown by the type of cattle found in the range area of the United States where most breeders have used registered bulls of the same breed for many generations. The result has been a uniform type of cattle in demand by feeders of the corn belt states. The mating of closely related animals has been highly successful in some cases and disastrous in others. Bakewell followed this practice, using animals of high merit, whereas Bates was not so successful. Twentieth-century breeders have followed this breeding practice only after using a sire so superior that a successor of equal or superior merit was difficult or impossible to find. Maintaining this standard of excellence by close breeding may also be possible when both parents are of high individual merit. Instances have occurred in which a new breed has been produced by crossing two or more well-established strains. In theory, the object of crossing two strains is to combine desirable characteristics possessed by each. Limiting factors are time and the expense of keeping the large numbers of animals necessary to fix the type. This system of breeding was followed in developing Polled Herefords, Polled Shorthorns, and the Santa Gertrudis breeds. A purebred sire has often been mated to purebred or high-grade females of another breed for the production of market animals. Crossing of two breeds generally produces offspring possessing greater vigour, ability to grow more rapidly, and ability to use feed somewhat more efficiently than either of the component purebred bloodlines.

After 1908 a number of co-operative dairy breeding associations were organized in the United States, the main purpose being to obtain for the members the services of registered proved sires at a reasonable cost. Another method of making extensive use of superior sires is by means of artificial insemination. Where artificial breeding associations were organized in the United States and trained technicians were available, this practice became a powerful medium of improving the masses of cattle of the country.

After 1900 there was growing appreciation of the value of scientific knowledge in breeding plans. A scientific approach to the study and practice of animal breeding has been made through the knowledge that the cell is the physical basis of inheritance and that all inheritance occurs in an orderly manner.

**BIBLIOGRAPHY.**—V. A. Rice, *The Breeding and Improvement of Farm Animals*, 4th ed. (1951); L. M. Winters, *Animal Breeding* (1948); J. L. Lush, *Animal Breeding Plans*, 3rd ed. (1945); John Hammond, *Farm Animals, Their Breeding, Growth and Inheritance* (1941).

**Nutritive Requirements.**—The feed consumed by cattle is used for a number of functions, depending to some extent on the purpose for which the animal is maintained. The larger part of the feed is required for normal body functions; the remainder is available for growth, fattening, reproduction and lactation. Sources of nutritive energy, protein, fat, minerals and vitamins are essential for the proper nutrition of cattle. Investigations of maintenance and production requirements have been of a highly technical nature and the results have provided feeding standards. As good pasture has a high content of protein, minerals and carotene, and is an economical source of nutritive elements, pasture improvement has received much attention in the United States. Pasture not only tends to maintain fertility in the herd, but also provides the cows with a surplus of various known and unknown nutritive essentials that can be stored in their bodies and thus ensure them against such deficiencies that might occur from the feeding of low-quality roughage during the winter. Experienced feeders have found that a liberal feeding of protein is necessary for high milk production, with a tendency to supply this element in the form of a vegetable protein from green leafy legumes. Vitamin and mineral requirements have also received considerable attention. The minerals most likely to be needed to supplement feeds are common salt, calcium, phosphorus, iodine and iron. Other minerals are sometimes required. Calcium and phosphorus requirements are closely associated, since the two elements are stored together in nearly fixed proportions in the bones and secreted together in nearly fixed proportions in the milk. If either element is deficient in the feed, both bone build-

ing and milk secretion are hindered. Phosphorus deficiency is a more common cause of nutritive trouble with cattle than calcium deficiency, since the soil in some parts of the world is deficient in phosphorus, and the forage of these areas is deficient in this element. Where cattle subsist almost entirely on the range it is practical and sometimes less expensive to supply phosphorus and perhaps other minerals from sources other than grain and forage crops.

As with minerals, vitamins are perhaps of greater concern in rations for growing and breeding stock than for fattening cattle. Vitamin A appears to be the one most likely to be deficient in feeds for dairy cows, or for steers fattened in areas where green leafy forage and yellow grain are limited. Newborn calves have no reserve of this element but it is supplied by colostrum. Carotene, the yellow pigment of the plant from which vitamin A is formed in the animal body, occurs in close association with the green-colouring matter of pasture plants and other green forage. As a rule, the greener the colour of the hay, the greater the amount of carotene, but hay stored for long periods tends to lose much of its carotene though still retaining most of its colour. Cattle must have an adequate supply of vitamin D to enable them efficiently to assimilate and utilize the calcium and phosphorus in their feed. It is believed that farm animals of all types generally receive an adequate supply of this vitamin by exposure to the sun's rays, depending on the intensity of the sunlight and its concentration of ultraviolet rays. Knowledge of nutritional requirements of cattle is very rapidly changing and still incomplete, and must constantly be reappraised as newer knowledge is obtained. (See also FEEDING STUFFS AND LIVESTOCK FEEDING.)

**BIBLIOGRAPHY.**—F. B. Morrison and others, *Feeds and Feeding; a Handbook for the Student and Stockman*, 21st ed. (1948); L. A. Maynard, *Animal Nutrition*, 3rd ed. (1951); R. R. Snapp, *Beef Cattle; Their Feeding and Management in the Corn Belt States*, 3rd rev. ed. (1939).

**Management, Care and Handling.**—The management and care of beef and dairy cattle are highly specialized practices. In the United States, for example, the feeding of beef cattle in the corn belt states, the production of feeder and grass-fat cattle on the ranges of the west, and the production of milk in the dairy sections of the northeast and middle-western states, all require a high degree of skill with different equipment and management practices. The range area is composed of plains and mountainous areas useful for grazing purposes. Practical ranch operation commonly involves attention to deferred and selective grazing to maintain the supply of forage, selection and culling of the breeding herd, controlled breeding, a well-arranged water supply and the production of winter feed where necessary. All of these practices are conducive to good condition of the breeding herd and a satisfactory crop of vigorous calves capable of making good gains.

On a well-managed ranch, a relatively high percentage of the investment is in the livestock rather than equipment. The range may be fenced or not, depending on the type of ranch. Corrals are used where large numbers of cattle are handled. In connection with the corral, a chute for holding cattle while being branded or vaccinated is usually a desirable investment. Range cattle are branded as a means of identification. Brands are recorded by the owner in the state where the ranch is located. Rounding up cattle or working the range is a time of great activity, especially when fat cattle are to be shipped, the breeding herd shifted to winter range, and calves separated from their dams to be sold as feeders or held on the ranch. The winter range is usually a pasture or range that offers some natural protection from winter storms and provides grass or browse that is suitable for winter grazing. When necessary, maintenance rations of cheap roughages or small amounts of protein supplement are fed during the winter or early spring.

The fattening of beef cattle in the United States is closely related to the production of calves and yearlings in the range area. The most important feeding area is the corn belt states of the middle west where calves or yearlings from the western ranges are fattened in dry lots. These cattle are fed corn and hay in feed bunks with some silage, salt, and minerals. Most cattle

feeders take it as a matter of course that cattle feeding cannot be made a successful enterprise without having hogs in the feed lot with the cattle. Inexpensive barns or sheds, feed racks and an adequate water supply are the most important items of equipment which with feed and labour go to make up the feeding operation.

While the production of feeder and grass-fat cattle in the range states is a highly specialized form of beef-cattle production in the United States, the maintenance of comparatively small breeding herds of registered cattle in many of the other states, as well as in the range area, requires a high degree of skill. Their care, management and breeding differ from those under which commercial range herds are handled. The registered cattle are produced primarily for breeding purposes and receive more attention and are fed more liberally as a rule than cattle produced primarily for slaughter. Breeding herds are made up of highly selected individuals conforming to the standards of the breed. Cows are bred to calve throughout the year, but most of the calves are born late in winter or early in the spring. During the summer months these calves run with their dams and may be fed grain in creeps while on pasture. Cows are usually maintained on pasture and roughage produced on the farm. Young cattle are given every opportunity to develop as considerable income is derived from the sale of young cattle, especially bulls, either at private sale or auction.

Dairy farming in the United States is usually distinct from the production of beef, but a certain amount of overlapping occurs. Approximately two-thirds of the dairy cows are cattle of specialized dairy breeds; the remainder consist of cattle of beef, dual-purpose, and mixed breeding. In commercial herds, replacements are commonly bought but some breeders grow their own replacements in order to improve production and lessen the danger of disease. Good cattle and modern methods of care and management are important elements in profitable dairying. Barns and equipment should be designed for producing and caring for milk efficiently and in a sanitary manner. The most common type of dairy barn in northern states is the two-story type with a loft for hay storage above the cows, whereas in the south where storage capacity is not so necessary, the one-story barn is more widely used. Practically every dairy farmer having a sufficient number of cattle to make the use of a silo profitable has one. Floors of dairy cattle barns are preferably of concrete, and the most common method of confining cows is with swinging stanchions. Water is often provided by means of automatic drinking fountains. Cows are milked twice daily, except in cases of advanced register or register of merit where three- and four-time milking may be practised. Milking machines are used successfully, especially where there is a labour shortage. On well-managed dairy farms each milking is weighed and butterfat tests are made at regular intervals. Most of the dairy breed associations have adopted herd-test plans under which all registered cows of the herd are tested. All these records are used as a part of the plan to show which cows are the most profitable. As feed is an important item in the cost of production, attention is given to the maintenance of pastures for summer feeding and the production of good-quality roughage for winter feeding. Good feeding, good breeding and the production of a sanitary product are the aims of the progressive dairyman.

**BIBLIOGRAPHY.**—R. R. Snapp, *Beef Cattle, Their Feeding and Management in the Corn Belt States*, 3rd rev. ed. (1939); C. H. Eckles, *Dairy Cattle and Milk Production*, rev. by E. L. Anthony and L. S. Palmer (1942); M. Clawson, *Western Range Livestock Industry* (1950).

#### CATTLE POPULATION AND WORLD TRADE

Estimates in round numbers of the cattle population of the world as averages for the years 1941-45 are shown in Table I.

Before the days of refrigeration as applied to transportation, most of the beef exports had been in the form of canned and cured meat. The first cargo of refrigerated beef was sent from the United States to England in 1874.

United States shipments of beef rose from 37,000,000 lb. in 1875-76 to 461,000,000 lb. in 1900-01. The marked expansion of beef exports from the United States from 1875 to 1900 was due in

TABLE I.—Number of Cattle in Principal Countries and by Continents  
(Average 1941-45\*)

Country	Number (Million head)	Country	Number (Million head)
North America, Central America and West In- dies		U.S.S.R. (Europe and Asia)	47
United States	80	Africa	
Mexico	12	Union of South Africa	13
Canada	9	Madagascar	6
Cuba	5	Kenya	5
Other	5	Tanganyika	3
Estimated total	111	Anglo-Egyptian Sudan	3
South America		Other	41
Brazil	44	Estimated total	74
Argentina	33	Asia	
Colombia	11	India†	177
Uruguay	6	Pakistan†	32
Other	17	China†	24
Estimated total	111	Turkey†	11
Europe		Thailand†	8
Germany (western)	12	Indonesia†	6
France	15	Burma†	5
Poland	10	Other	23
United Kingdom	9	Estimated total	286
Italy	8	Oceania	
Czechoslovakia	4	Australia	14
Yugoslavia†	4	New Zealand	5
Ireland	4	Estimated total	19
Rumania†	3	Estimated world total	745
Other†	28		
Estimated total	97		

Source: United States Department of Agriculture, agricultural statistics 1951. Compiled from official statistics of foreign governments, reports of the United States foreign service officers and other information.

\*Average for 5 year period if available, otherwise for some year or years within or near

†Buffaloes included.

‡Estimate for China includes China Proper (22 Provinces) Manchuria, Jehol and Sinkiang (Turkestan).

large measure to the settlement of new regions and the attendant expansion of livestock production in the United States and to the growing industrialization of Europe with the increasing demand for imported foodstuffs. But early in the 20th century an expanding domestic market, rapidly increasing competition from the southern hemisphere, and some expansion of livestock and meat production in northern and central Europe were responsible for a sharp decline in United States beef exports. By 1905 Argentina had surpassed the United States as an exporter of refrigerated beef and by 1914 United States exports of fresh beef had fallen to 6,000,000 lb. Exports of cured beef amounted to 23,000,000

TABLE II.—World Trade in Cattle, 1929-50  
(In thousands of heads)

Imports				
Countries	Average 1929-33	Average 1934-38	Average 1939-43	Average 1946-50
United Kingdom	762	682	787	417
United States	203	361	764	400
Italy	182	101	27	125
Germany	153	156	...	227
U.S.S.R.	114	121	...	...
Austria	72	23	...	5
France	64	77	...	17
Greece	61	77	48	39
Chile	56	23	39	142
Japan	51	65	...	...
Czechoslovakia	46	6	...	12
Belgium	44	19	...	...
Argentina	41	1	...	...
Union of South Africa	31	54	107	173
British Malaya	28	27	17	7
Switzerland	13	9	2	27
Brazil	2	21	70	17

Exports				
Countries	Average 1929-33	Average 1934-38	Average 1939-43	Average 1946-50
Ireland	727	664	784	456
Denmark	145	128	163	146
Mexico	131	200	541	91
French West Africa	99	79	...	114
Hungary	96	76	75	...
Yugoslavia	96	61	...	12
Canada	93	197	293	395
Turkey†	88	26	20	32
Argentina	76	81	134	294
Rumania	76	49	30	...
Korea	50	67	28	...
France	43	7	...	35
Uruguay	33	66	119	2
China	30	33	...	...
Netherlands	25	3	...	15
Austria	18	3	...	4
United States	5	0	3	15

lb. in that year. From 1921 to the early 1950s imports of beef into the United States were larger than exports in most years.

From 1924 to 1950 the United Kingdom was by far the greatest importer of live cattle, buying mostly from Ireland as it had not permitted imports from the continent for decades. However, the economic war waged by the two countries between 1931 and 1938 greatly reduced the number imported. Central Europe was a second deficit region for cattle. German supplies came chiefly from Denmark. Austria and Czechoslovakia, Italy and Greece were largely supplied from Bulgaria, Hungary, Rumania and Yugoslavia. United States imports came mostly from Canada and Mexico.

(A. C. Ck.)

#### DISEASES OF CATTLE

The greatest hazard in rearing cattle, practically everywhere, is disease. The most destructive diseases are caused by bacteria, protozoa and filterable viruses, but fungi, parasites, poisons, malnutrition and metabolic disturbances also exact heavy tolls.

Foot-and-mouth disease (*q.v.*), or aphthous fever, probably is the most widespread and contagious of all infectious maladies of animals. Cattle and other cloven-footed animals, including swine, sheep and goats, are susceptible. The most rigid quarantines and restrictions of movements of animals and animal products frequently fail to control the spread of the malady. In the U.S., the immediate slaughter of affected and exposed animals completely eradicated the infection on six occasions after 1900. This procedure has been followed in England and adopted from time to time in some countries on the European continent, but the proximity of areas in which the disease is established is a constant hazard. The disease is prevalent in most of Europe, Asia, Africa and South America but (in the early 1950s) had not occurred in the United States since 1929. In countries where the disease is enzootic or where infection recurs from adjoining infected countries, total eradication has been found economically unfeasible and measures to control the infection include prophylactic vaccination, using variations of the product originally developed by S. Schmidt of Denmark and O. Waldmann of Germany in the late 1930s. Some 60,000,000 vaccinations of cattle, goats, sheep and swine were applied by the Mexico-United States Commission for Eradication of Foot-and-Mouth Disease in Mexico, where after a five-year campaign, the disease was finally eradicated in Sept. 1952. Approximately 1,000,000 animals were destroyed in the cooperative program financed by both countries.

Rinderpest (*q.v.*), or cattle plague, a highly fatal, contagious, filterable-virus disease, was widespread in the 19th century practically all over the world but has not occurred in North America. Vigorous eradication measures were widely applied, and it remains only in Asiatic countries and parts of Africa. The disease is characterized chiefly by severe gastrointestinal involvement. Control in countries where the disease is enzootic involves quarantines and use of preventive vaccines prepared with chemically inactivated tissue or virus attenuated by propagation in other species—goat, rabbit, chicken embryo.

Contagious pleuropneumonia, or lung plague, was prevalent in many countries before the 20th century. By means of quarantines and slaughter of affected animals, the disease has been eradicated from Europe and North America. It persists in Asia, Australia, and parts of Africa.

Tuberculosis (*q.v.*) in cattle is a widespread, chronic, bacterial disease caused by an organism closely related to that of human tuberculosis. Almost all mammals, including man, are susceptible to bovine tuberculosis. Cattle are relatively insusceptible, however, to the human and avian types of the infection. The bovine infection may be readily transmitted by infected milk and milk products. Pasteurization is an effective safeguard. The disease may be successfully controlled by quarantines and repeated application of the tuberculin test. The test is accurate to a high degree even in mildly affected animals. The infected animals may be placed in quarantine, thus reducing spread of the disease, or they may be slaughtered at once. The latter procedure, with quarantines and disinfection of infected premises, has been followed in the United States. The extent of bovine tuberculosis,

formerly averaging about 5% and much higher in some areas, has been reduced to less than 0.5% in all parts of the U.S. Repeated testing is necessary, however, as long as any infection remains.

Brucellosis (*q.v.*), or Bang's disease, which is characterized by abortion and sterility, is a problem wherever breeding operations are conducted. The infection, caused by *Brucella abortus*, is prevalent to a greater or lesser extent throughout the world. Diseased animals are detected by tests of the blood or milk. Control may be effected by segregation or destruction of affected animals, with appropriate quarantine measures, with or without the aid of preventive vaccine. The most widely used vaccine is prepared with the so-called strain 19 of *Brucella abortus* which is especially useful in immature cattle. Man frequently contracts the infection, referred to as undulant fever, from infected cattle, swine or goats.

Mastitis, or inflammation of the udder, rivals all bacterial infections of dairy cattle in the aggregate loss it causes. It occurs in acute and chronic forms. Death rarely results but the infection, which may be due to streptococci, staphylococci or other organisms, causes alteration and material reduction of the milk secretion. Since the development of the sulfonamides and other antibiotic agents such as penicillin and streptomycin, considerable success has been achieved in treatment. The disease may be controlled by segregation of infected animals, sanitation and careful milking practices.

Johne's disease, or paratuberculosis, is a chronic disease of cattle, which causes considerable loss in Great Britain, North America and other parts of the world. The causative organism, *Bacillus (Mycobacterium) paratuberculosis*, produces a chronic dysentery which results in progressive emaciation and death in many cases.

Two acute, fatal, bacterial diseases of cattle are anthrax and black quarter (blackleg). These occur in quite definitely defined districts in widely separated parts of the world. In these enzootic areas, vaccination with biological products prepared from the respective causative bacteria is generally effective in control. Anthrax may be acquired by other animals and also by man.

Bovines, like other ruminants, possess a complex stomach having four compartments, the largest of which, the rumen, or paunch, has a capacity of as much as 50 gal. This anatomical peculiarity is responsible for frequent digestive disturbances. Bloat and impaction are common. Cattle also frequently suffer from perforations of the stomach by foreign metallic objects which are commonly ingested with the feed and cause death if they penetrate the heart sac.

Calves, especially those of the dairy breeds, commonly develop fatal enteric disorders unless special care in feeding and sanitation is taken.

Dairy cows are prone to develop metabolic diseases. Milk fever, or parturient paresis, is the commonest of these. It occurs usually just after parturition and invariably results in death if treatment is not given. Another such disease is acetonaemia, or ketosis, in which there are acidosis, subnormal quantities of sugar in the blood and faulty fat metabolism, with excess formation of ketones in the body.

Cattle may be afflicted with other diseases, infectious and otherwise, which cause considerable losses. These include actinobacillosis and actinomycosis, both commonly referred to as lumpy jaw; cowpox, which is closely related to smallpox; epithelioma (cancer eye), hyperkeratosis; infectious keratitis (pink-eye); leptospirosis; leukemia; pasteurellosis (haemorrhagic septicaemia); rabies; rickets; and trypanosomiasis.

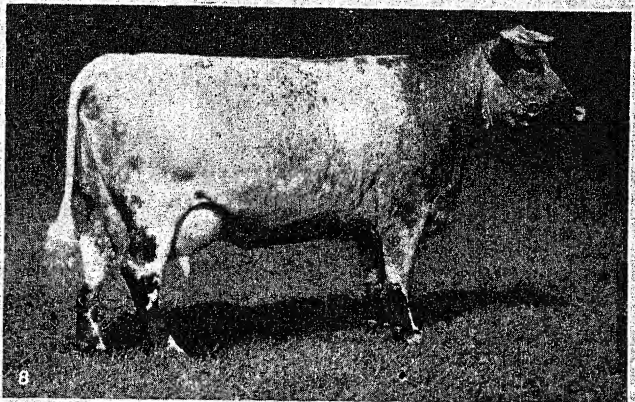
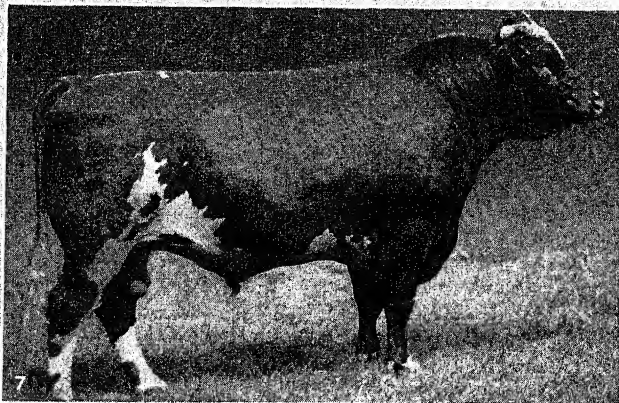
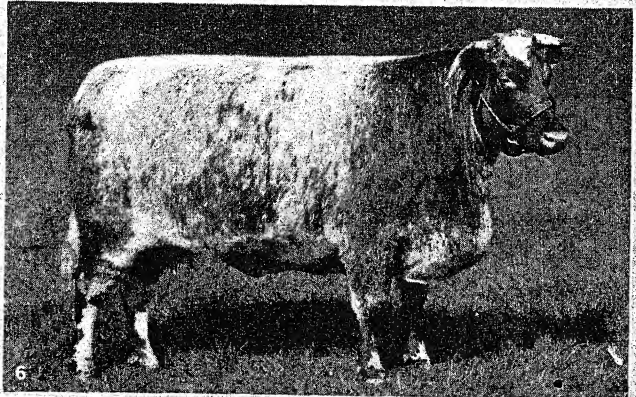
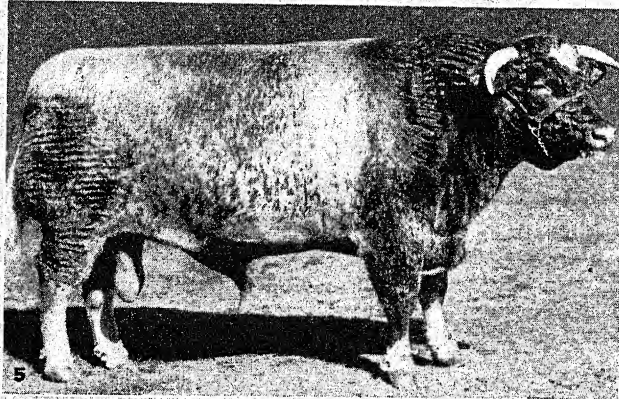
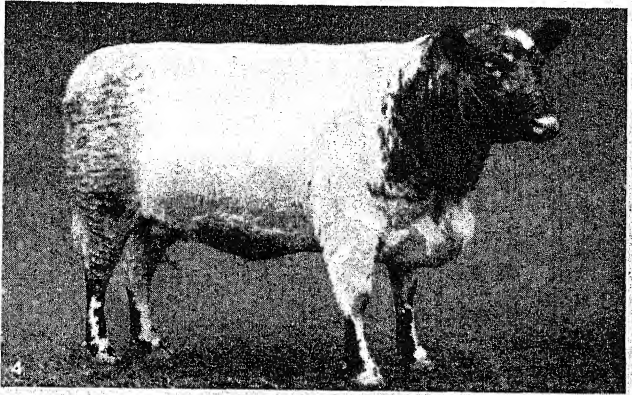
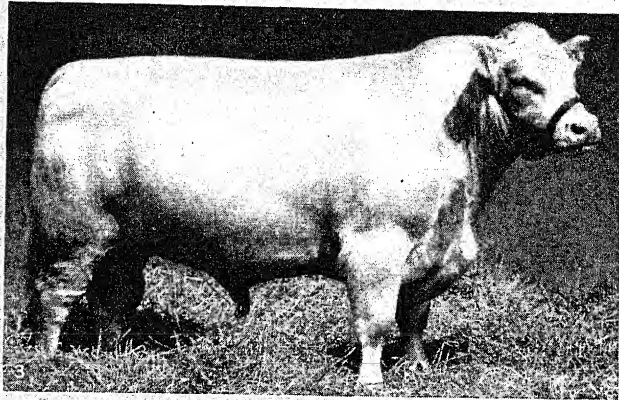
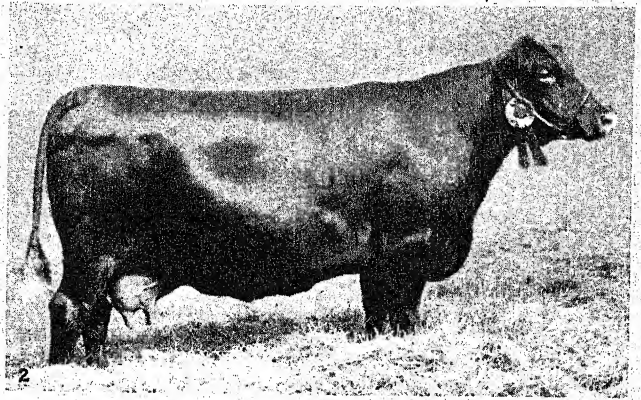
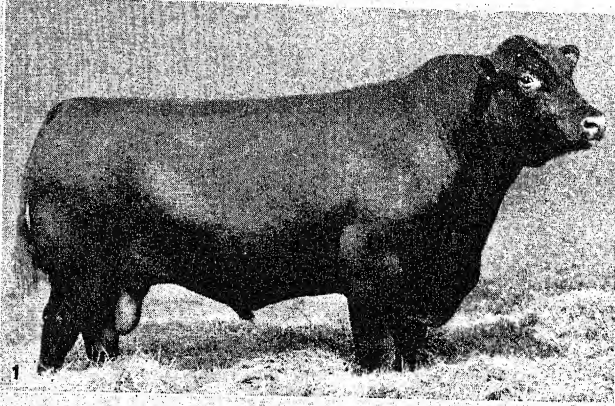
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**Parasites of Cattle.**—Parasites of cattle, belonging to such zoological groups as protozoa, worms and arthropods, cause extensive economic loss. Successful control measures generally consist in attacking the various parasites at vulnerable points in their life cycles.



# CATTLE

PLATE



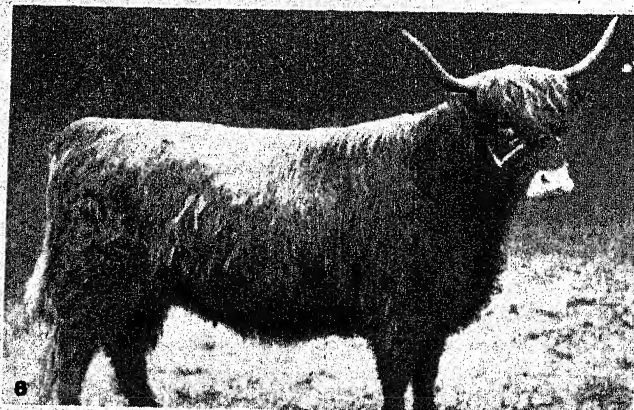
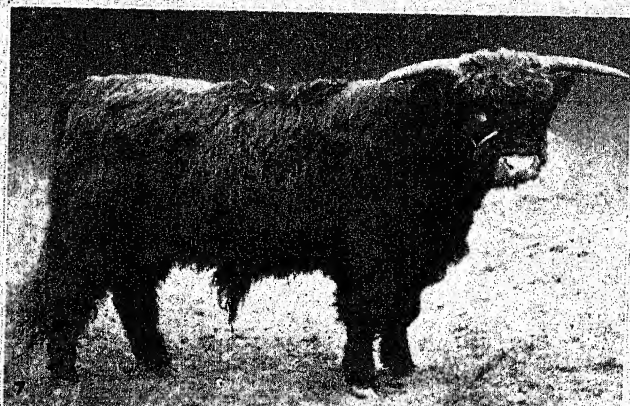
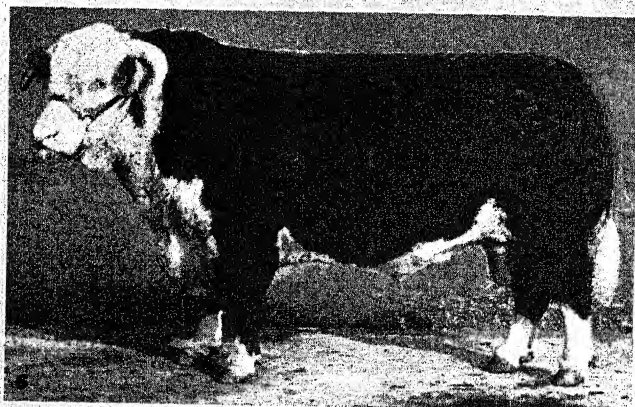
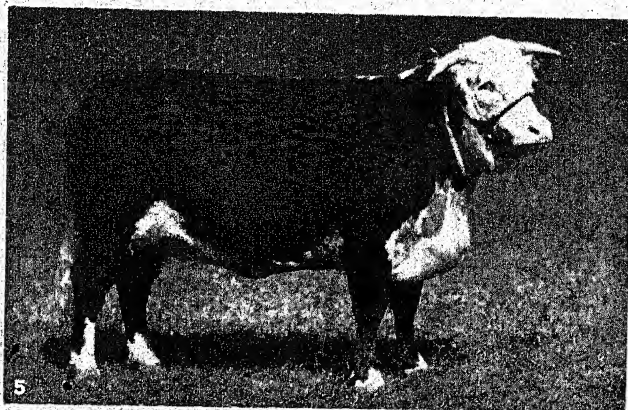
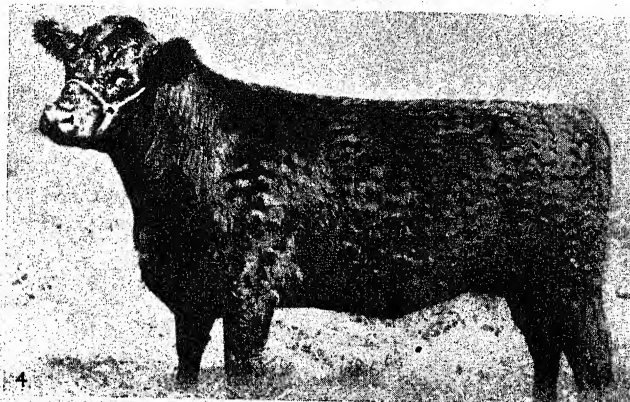
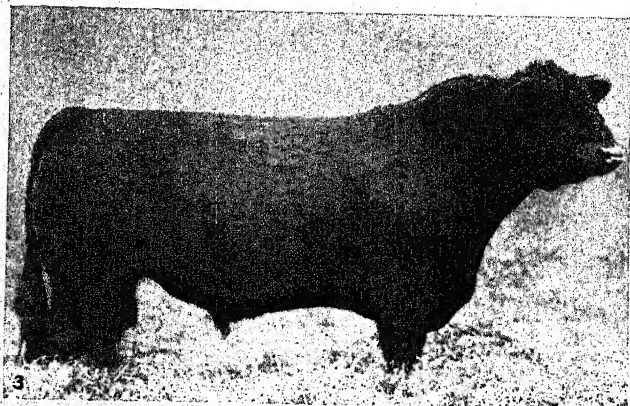
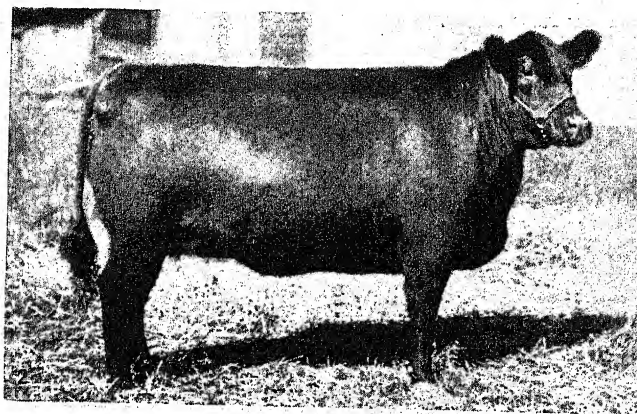
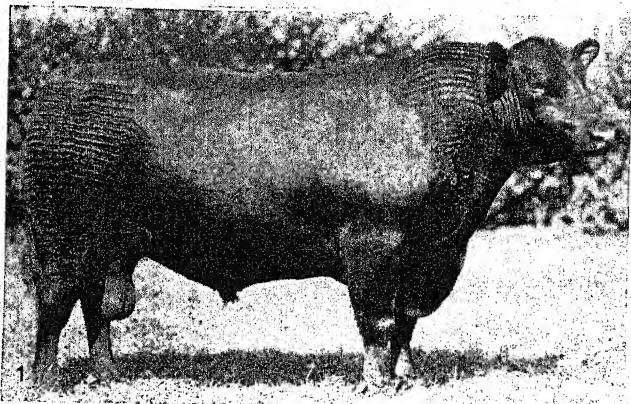
PHOTOGRAPHS, (1, 2, 3, 4, 7, 8) ROBERT F. HILDEBRAND, (5, 6) H. A. STROHMEYER, JR.

## BREEDS OF CATTLE

1. Red poll bull
2. Red poll cow
3. Polled shorthorn bull
4. Polled shorthorn cow

5. Shorthorn bull
6. Shorthorn cow
7. Dairy shorthorn bull
8. Dairy shorthorn cow

# CATTLE



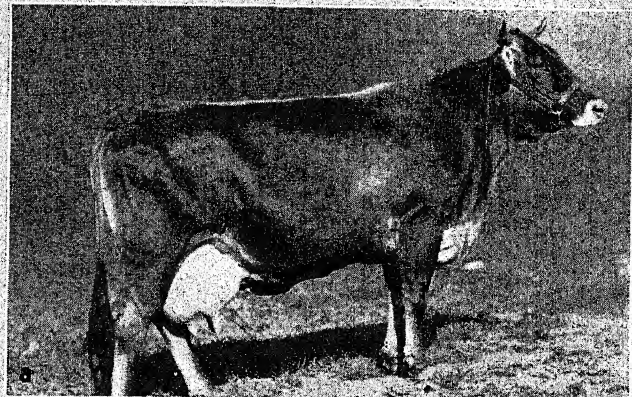
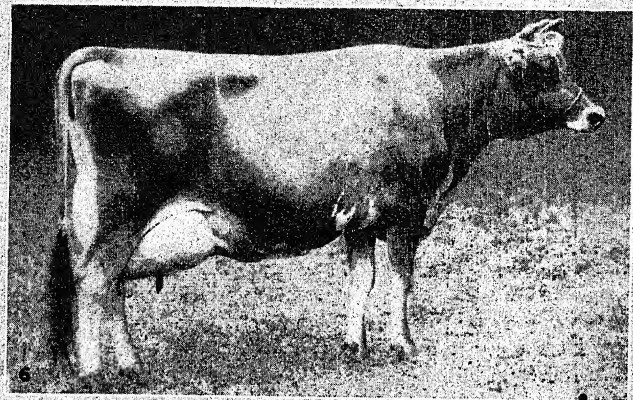
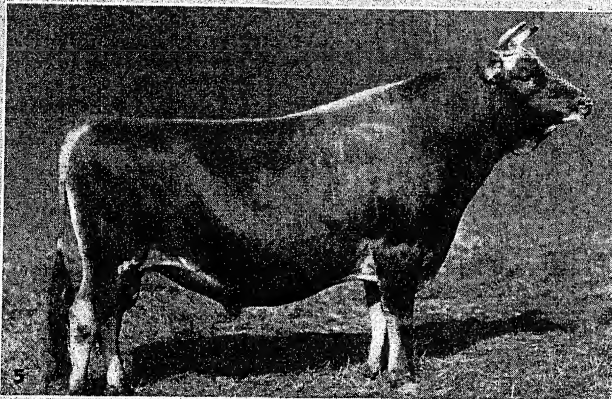
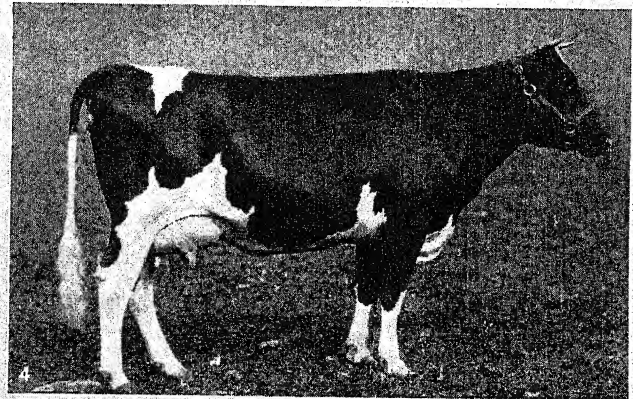
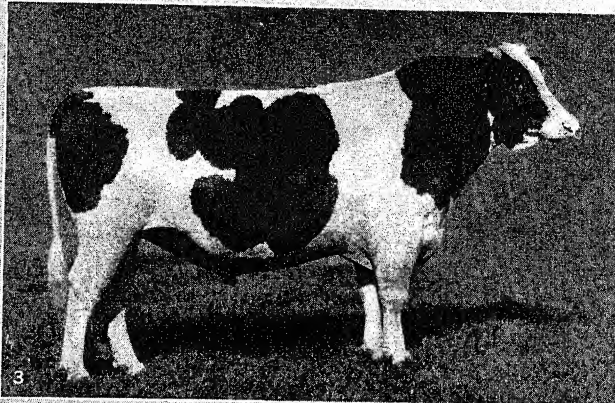
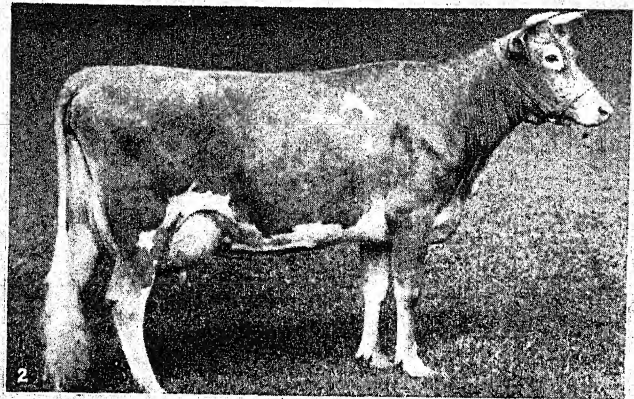
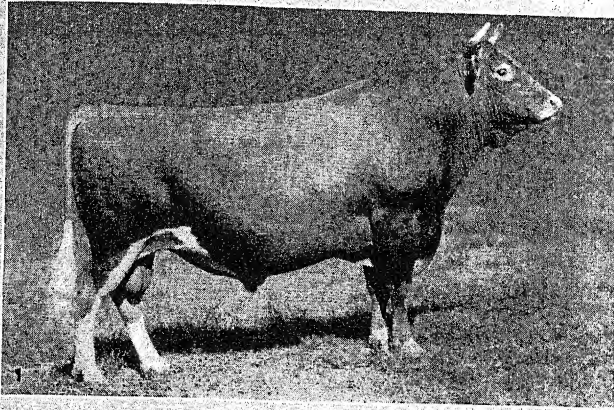
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## BREEDS OF CATTLE

1. Aberdeen Angus bull
2. Aberdeen Angus cow
3. Galloway bull
4. Galloway cow

5. Hereford cow
6. Hereford bull
7. Highland bull
8. Highland cow





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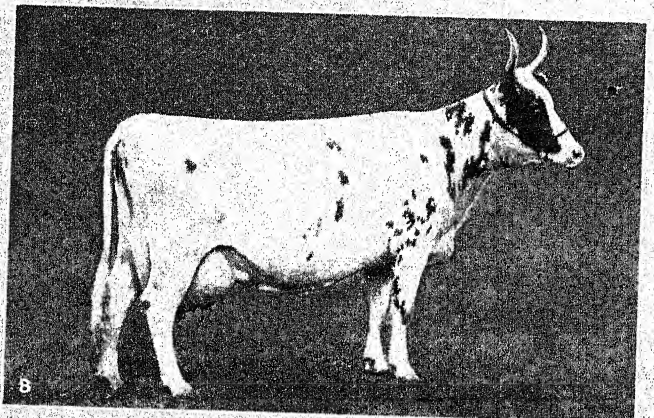
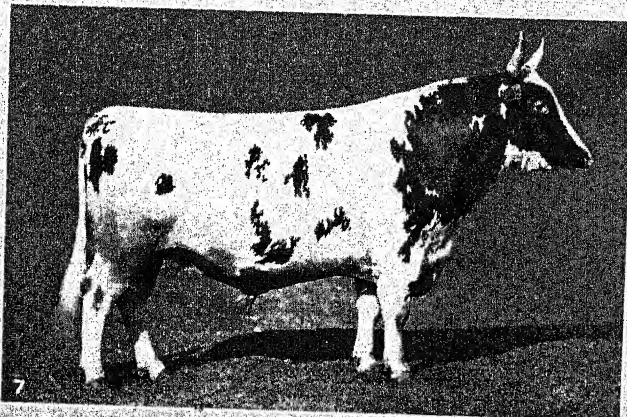
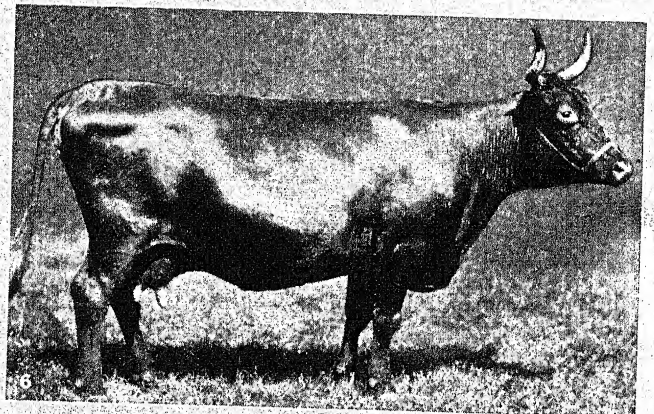
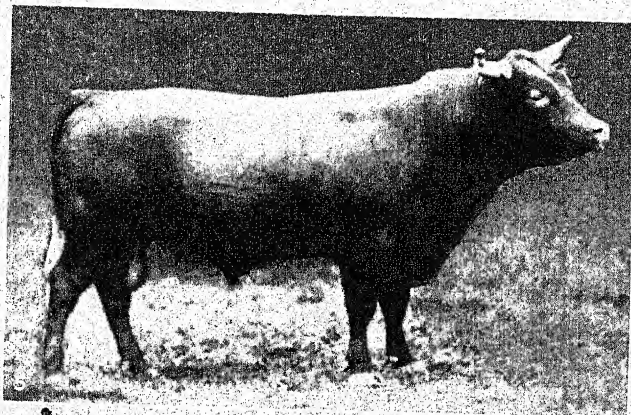
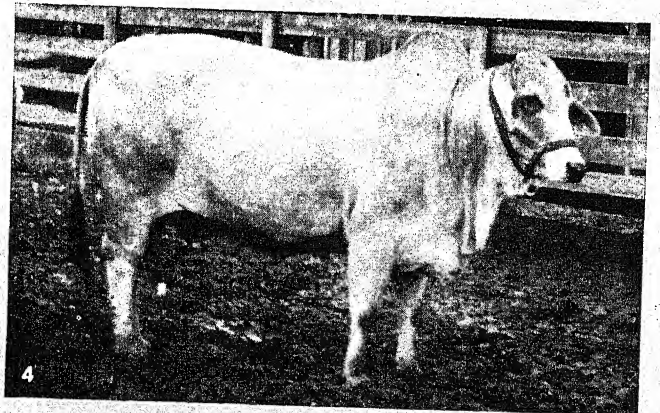
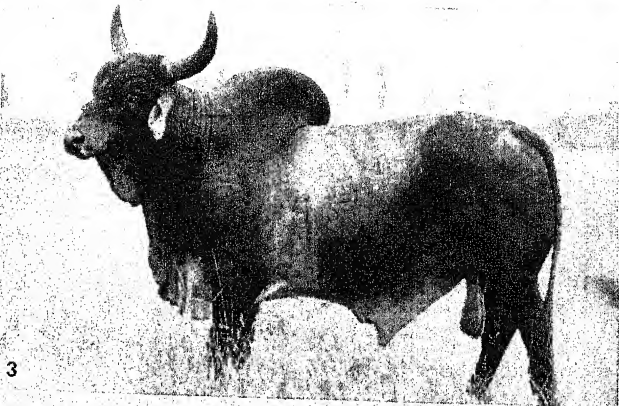
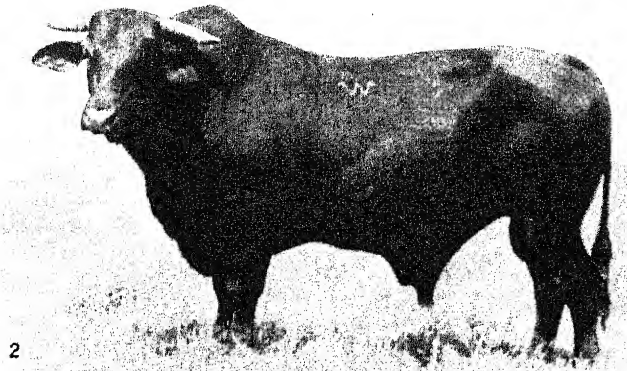
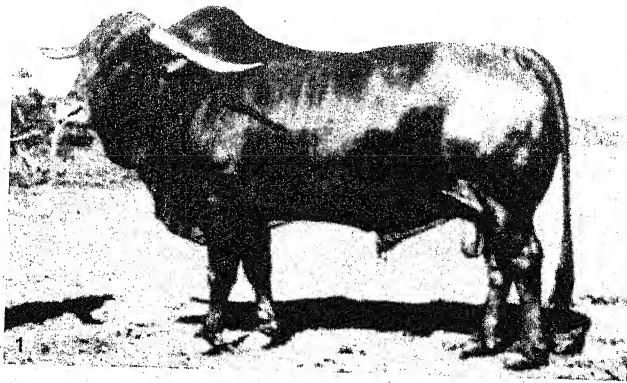
## BREEDS OF CATTLE

1. Guernsey bull
2. Guernsey cow
3. Holstein Friesian bull
4. Holstein Friesian cow

5. Jersey bull
6. Jersey cow
7. Brown Swiss bull
8. Brown Swiss cow



# CATTLE

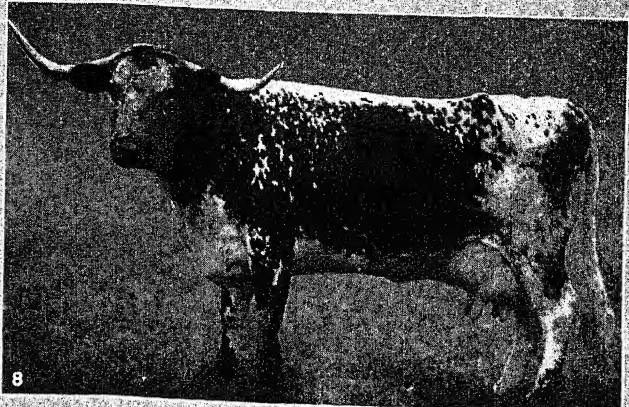
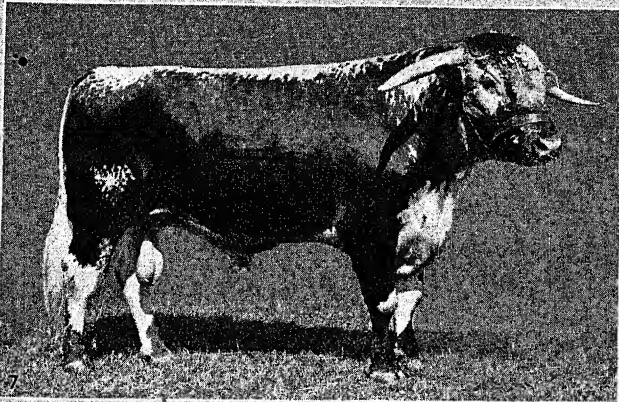
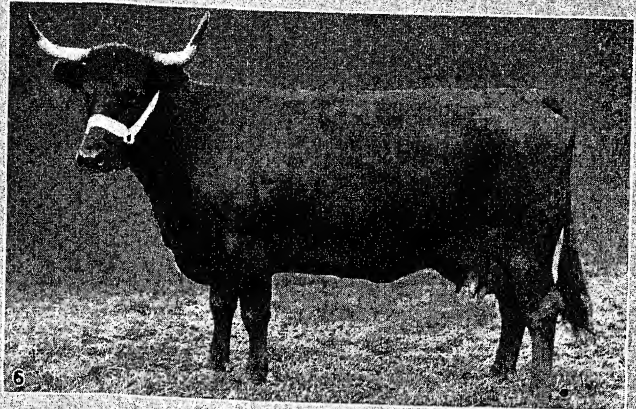
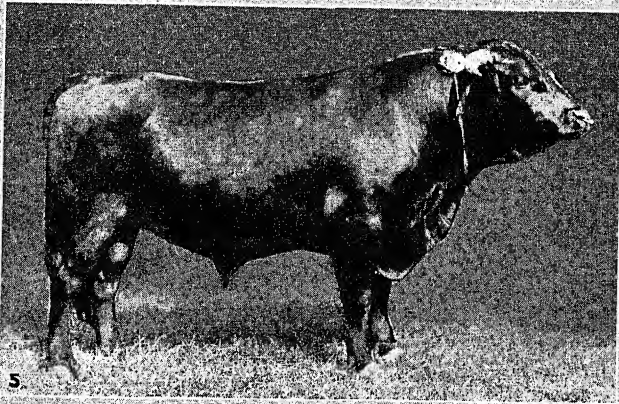
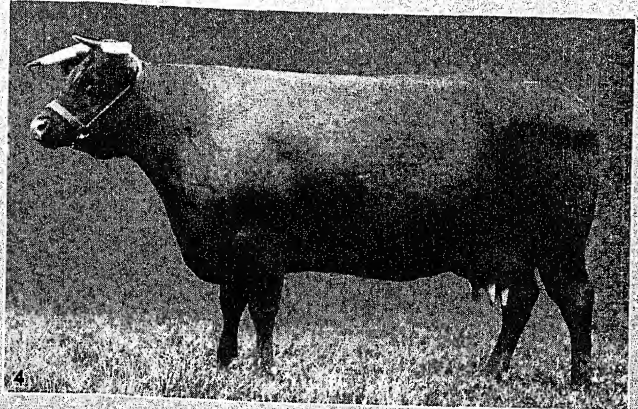
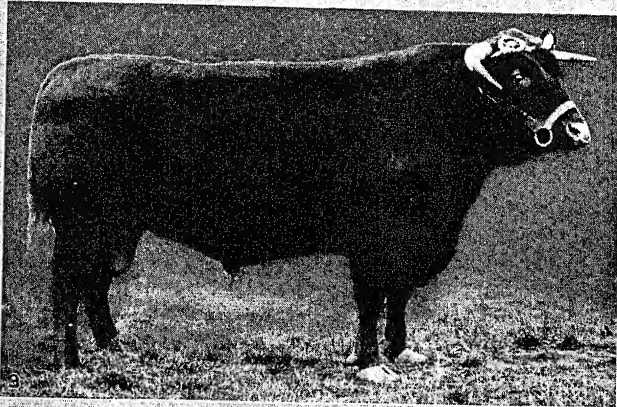
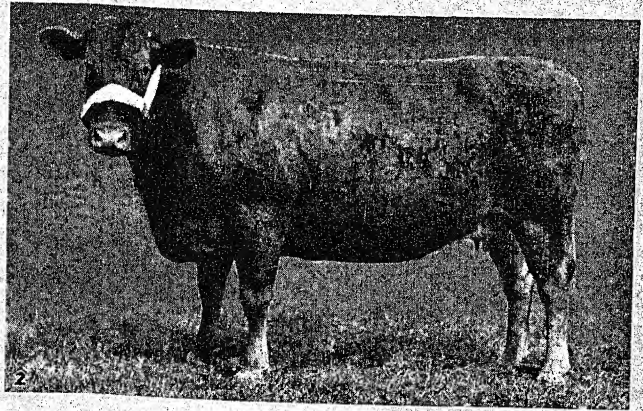
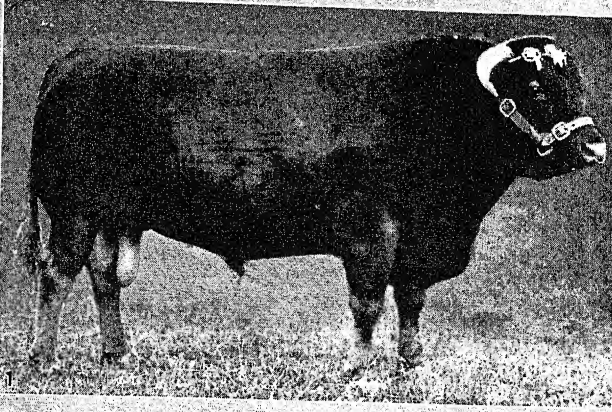


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## BREEDS OF CATTLE

1. Africander bull
2. Santa Gertrudis bull
3. Brahman (zebu) bull
4. Brahman (zebu) cow

5. Devon bull
6. Devon cow
7. Ayrshire bull
8. Ayrshire cow



PHOTOGRAPHS, (1, 2, 3, 5, 7) SPORT AND GENERAL PRESS AGENCY, (4, 6, 8) "THE FARMER AND STOCKBREEDER"

## BREEDS OF CATTLE

1. South Devon bull
2. South Devon cow
3. Sussex bull
4. Sussex cow

5. Welsh bull
6. Welsh black cow
7. Longhorn bull
8. Longhorn cow





The diseases caused by protozoa, or one-celled animals, are especially important in tropical and subtropical countries. Among the most destructive are piroplasmosis or tick fever, anaplasmosis, surra and nagana. All these diseases are caused by minute parasites that live in the red blood cells or in the blood stream, and are usually transmitted by blood-sucking arthropods such as ticks and flies; they are generally characterized by fever and destruction of the red cells. The monetary loss from these diseases is very great. However, by mid-20th century practically all of these losses had been eliminated in the United States through eradication of cattle ticks by systematic dipping of ticky cattle in standardized arsenical dips. Control of other protozoan blood diseases, especially those transmitted by flies, has been less satisfactory.

Other protozoan diseases of cattle are coccidiosis and venereal trichomoniasis. Coccidiosis is an intestinal disease characterized by bloody diarrhoea and emaciation. It is caused by sporozoan parasites that infect the inner lining of the intestine. The infection is largely in calves and is controlled by strict sanitation. Venereal trichomoniasis is caused by a small flagellate organism that is transmitted through coitus. Infection results in early abortion, sterility and other breeding difficulties.

The worm parasites are flukes, tapeworms and roundworms. The common liver fluke (*Fasciola hepatica*) lives in the bile ducts; it causes extensive damage to the liver and general unthriftiness of the infected animal. The complicated life history and control measures are the same as those discussed under diseases and parasites of sheep. (See SHEEP: *Parasites of Sheep*.)

Several species of tapeworms infest the digestive tract but these worms do not appear to cause extensive injury. The larval or bladderworm stage of the common tapeworm (*Taenia saginata*) of man occurs in the muscles and causes a condition known as "measly beef." Cattle acquire the infestation by swallowing the eggs while grazing on pastures that have been contaminated by excrement from tapeworm-infested persons.

Important roundworm parasites are lungworms, stomach worms and intestinal threadworms of which there are numerous species. All these worms are acquired by picking up the infective larvae while grazing. Roundworms cause unthriftiness, anaemia and digestive disturbances, especially diarrhoea. The injurious effects are most pronounced in calves and in animals under two years of age.

Sanitation, pasture rotation and avoidance of overstocking tend to control worm parasites. Medicinal treatment with anthelmintic drugs, especially phenothiazine, is of value in controlling stomach and intestinal roundworms.

The arthropod parasites include the ticks, mites, lice and flies. Aside from ticks and certain flies that transmit tick fever, anaplasmosis and other protozoan blood diseases, the most injurious arthropod parasites are the warble flies, *Hypoderma lineatum* and *H. bovis*. These flies lay their eggs on the legs of cattle. In a few days the eggs hatch and the young larvae penetrate the skin. They then migrate through the tissues of the body and eventually reach the back. Here the larvae or grubs, as they are sometimes called, complete their growth and produce swellings. The skin over each swelling becomes perforated and the holes so formed permit the larvae to breathe and to escape when they have completed their growth.

A somewhat similar fly larva (*Dermatobia hominis*), commonly referred to as nuche or gusano, infests cattle in Central and South America. The adult fly does not deposit its eggs directly on the skin as do the warble flies, but lays them on the bodies of mosquitoes and other bloodsucking insects. The eggs hatch and the larvae crawl onto the skin when the insect is feeding.

Hatching is stimulated by the warmth of the victim's body. Ox warbles may be controlled to some extent by manual extraction of the grubs or by the use of dusts, dips or washes containing insecticidal substances such as rotenone.

Other arthropods such as ticks, mites, lice and flies inflict considerable injury to animals by abstracting blood and causing irritation to the skin.

Such parasites living habitually on their hosts may be controlled

by the use of insecticidal dips, washes or dusts; flies are best controlled by destruction of their breeding places.

BIBLIOGRAPHY.—*Diseases of Cattle*, U.S. Department of Agriculture, Washington (1942); "Keeping Livestock Healthy," *Yearbook*, U.S. Department of Agriculture, Washington (1942).

(E. W. PE.; X.)

**CATULLUS, GAIUS VALERIUS** (84?–54 B.C.), the greatest lyric poet of Rome. As regards his names and the dates of his birth and death, the most important external witness is that of Jerome, in the continuation of the Eusebian *Chronicle*, under the year 87 B.C., "Gaius Valerius Catullus, scriptor lyricus Veronae nascitur," and under 57 B.C., "Catullus xxx. aetatis anno Romae moritur." There is no controversy as to the gentile name, *Valerius*. Suetonius, in his *Life of Julius Caesar* (ch. 73), mentions the poet by the names "Valerium Catullum." Other persons who had the *cognomen* Catullus belonged to the Valerian gens, e.g. M. Valerius Catullus Messalinus, a *delator* in the reign of Domitian, mentioned in the fourth satire of Juvenal (l. 113).

Inscriptions show, further, that *Valerius* was a common name in the native province of Catullus, and belonged to other inhabitants of Verona besides the poet and his family (Schwabe, *Quaestiones Catullianae*, p. 27). Scholars have been divided in opinion as to whether his *praenomen* was *Gaius* or *Quintus*, and in the best MSS. the volume is called simply *Catulli Veronensis liber*. For *Gaius* we have the undoubted testimony, not only of Jerome, which rests on the much earlier authority of Suetonius, but also that of Apuleius. In support of *Quintus* a passage was quoted from the *Natural History* of Pliny (xxxvii. 6, 81). But the *praenomen* Q. is omitted in the best MSS., and in other passages of the same author the poet is spoken of as "Catullus Veronensis." The mistake may have arisen from confusion with Q. Catulus, the colleague of Marius in the Cimbric War, himself also the author of lyrical poems.

Internal evidence shows that certain poems were written two or three years after 57 B.C., the date of Catullus' death according to Jerome. Thus cxiii. was composed in 55 B.C., lv. either in that year or later, while xi., xxix., xlv. all appear to be written after Caesar's first invasion of Britain (55 B.C.). He is described by Ovid as "hedera juvenalia cinctus Tempora,"—a description somewhat more suitable to a man who dies in his thirtieth year than to one who dies three or four years later. Since no poem is certainly later than 54 B.C., it is best to retain Jerome's reckoning of Catullus' age as 30 years but to suppose him to have lived from 84 to 54 B.C.

Jerome's statement that Catullus was born at Verona is confirmed by other authorities. His father was important enough to act as Caesar's host, and it was probably at or near Verona that Caesar accepted the poet's apologies for the attacks on himself and Mamurra (xxix. and lvii.; see Suetonius *Jul.* 73); xciii. may represent Catullus' reply to earlier advances on Caesar's part. The poet's attitude was not due to republican sentiment, but the result of personal animosities. In xxix. he arraigns Pompey along with Caesar, and in xi. he recognizes the latter's greatness.

Catullus' complaints of poverty are not to be taken very seriously. He possessed a villa at Tibur as well as a retreat at Sirmio on Lake Garda, and the poems prove that he had the means to figure in the best society. Still his purse was often no doubt, as he says, "full of cobwebs" (xiii. 8).

On reaching manhood Catullus was sent to try his fortune at Rome. The premature death of his brother in Asia Minor seems to have recalled him to Verona (cf. lxviii.). In 57 B.C. he made a belated attempt at a public career by accompanying Memmius, the patron of Lucretius, to Bithynia, of which province Memmius had been appointed governor. His hopes of lining his purse at the expense of the provincials were not realized, and in the spring of 56 B.C. he left Nicaea (xlv.) and returned to Italy, perhaps on his own yacht (cf. iv.); *en route* he visited his brother's tomb in the Troad (ci.). His delight at seeing Sirmio once more is charmingly expressed in xxxi. The poems show that his last years were divided between Verona and Rome. As a Transpadane, Catullus found many compatriots in the capital, and among them several representatives of the new movement in poetry led by Valerius Cato.

himself a native of Cisalpine Gaul. The poems reveal him on terms of intimate friendship with certain of the younger members of this circle; e.g., Calvus (xiv., l., liii., xcvi.), Cinna (x., xcv., cxiii.), Cornificius (xxxviii.). He appears to have been acquainted with the two leading orators of the day—Cicero (xlix.), and Hortensius (lxv. and xcv.). Among friends of less eminence he counted a Caelius (lviii.) whom some identify with Cicero's protégé M. Caelius Rufus, thinking that lxix. and lxxvii. addressed to a Rufus, refer to the same man; this is possible, but in that case another Caelius must be meant in c., since Cicero's friend was not a native of Verona. Particularly dear to Catullus, but otherwise unknown to us, were two friends Veranius and Fabullus (ix., xii., xliii., xxviii., xlvii.), while in i. he dedicates his *libellus* to the biographer and historian Cornelius Nepos, who in after years left it on record that in his opinion Catullus and Lucretius were the two greatest poets of that period (Nepos, *Life of Atticus* xii., 4). Among Catullus' enemies the most furiously attacked in the poems—apart from Caesar and his lieutenant—are the pair Furius and Aurelius (xv., xvi., xxi., xxiii., xxiv., xxvi.), and one Gellius, who is the target of no fewer than seven epigrams. Other victims of his invective are Ravidus (xl.) and Rufus (see above), his rivals in love; a freedman Thallus (xxv.); a ridiculous fop Egnatius (xxxvii., xxxix.). To a false friend Alfenus he writes more in sorrow than in anger (xxx.). The most important influence in Catullus' life was that of his mistress Lesbia. Her real name was Clodia (Apuleius, *Apol.* 10); Catullus chose the pseudonym for its connection with Sappho (li., a translation of a famous ode of Sappho, was perhaps a first tribute to his mistress' charms). There can be little doubt that Clodia was the notorious sister of the demagogue, married in 63 B.C. to Q. Metellus Celer and suspected of responsibility for his death in 59 B.C. Cicero mentions her several times in his Letters, and has left a graphic picture of this dangerous beauty in the speech (*Pro Caelio*), in which he defended M. Caelius Rufus (see above), also one of her lovers, against the charge of having tried to poison her. Though Cicero writes as an advocate and Catullus as a lover, their descriptions are not inconsistent, and the final proof of identity is contained in lxxix., the *Lesbius* of which poem clearly covers a Clodius, not, however, the demagogue P. Clodius, but Sex. Clodius, a kinsman and associate of Publius, whom rumour represented as having relations with Clodia (Cicero, *De Dom.* 25) similar to those attributed to *Lesbius* by Catullus. A recent attempt to identify Lesbia with a younger sister and namesake of Metellus' wife, who married L. Lucullus and was divorced by him for alleged relations with her brother, appears unconvincing. Catullus was Clodia's lover during Metellus' lifetime (cf. lxxxiii.); the husband's death apparently brought other rivals on the scene, and Catullus' allegiance had been sorely tried before he left for Bithynia, but xi., the final renunciation, is subsequent to his return (see above). The data do not suffice to fix the course of the liaison more exactly.

Catullus' poetical activity began soon after his assumption of the *toga virilis* (cf. lxxviii. 15–17); references in the poems suggest that he sometimes published his pieces separately or in small groups (cf. i. 4; xvi. 3.; xlii.; xliii. 7; liv. 6). Later (cf. i.) he formed a collection of his compositions and dedicated it to Cornelius Nepos, but it is a moot point what this *libellus* contained, whether it was identical with the present collection, and, if not, how the latter was formed. As arranged in the mss., the poems fall into three sections, viz., (1) i.–lx., shorter lyric pieces, (2) lxi.–lxviii., longer poems in a variety of metres, (3) lxix.–cxvi., elegiac epigrams. The hypothesis most in favour recently is that our present collection was formed in outline by Catullus himself before his death, and that afterwards his literary executors inserted in the groups so arranged sundry other material discovered among his remains, including unfinished pieces like xiva. and lx.

Though Catullus was an Italian of the Italians in character and temperament, it is impossible to appreciate his poetry correctly except in relation to Greek and more particularly Alexandrian poetry. Like that of the other *novi poetae*, his work has two aspects. On the one hand we have the shorter pieces in which any and every emotion of the moment finds instant expression, on the

other the poems which earned Catullus the title of *doctus*, considerably longer than his *nugae* but short when compared with the *Annales* of a Volusius (xxxvi., xcv.). The poet's debt to Alexandrian models in these longer compositions, though hard to control to-day owing to the fragmentary survival of later Greek poetry, is universally admitted. Catullus himself declares lxvi. to be a translation from Callimachus (cf. lxv. 16); lxiv. is cast in the mould of a Hellenistic *epyllion*; lxviii., a mixture of the personal and narrative elegy, framed as a letter to a friend, also has Alexandrian forbears; lxii. adapts an epithalamium of Sappho after the manner of the later Greeks; even lxiii. (the *Attis*) which gives an impression of striking originality probably follows in the track of Callimachus or some other Alexandrian. The most original of these longer poems is probably lxi., the epithalamium for Manlius Torquatus and Vinia (or Iunia) Aurunculeia, since here Catullus has tried to fuse the native *versus Fescennini* with the Greek *hymenaeus*; it contains touches, e.g., 216–220, marked by a tenderness unknown otherwise before Virgil. Even in the *nugae* Catullus' debt to Greece is greater than was realized till recently. Just as the life of the *γῆντροι* with its interest centred on love and letters had been anticipated by that of the later Greeks (compare l. with the lines of Hedylus [*flor. circ.* 290 B.C.] preserved in Athenaeus xi. 473a; see also xxxv. and xxxviii.), so the forms, lyric *παίγνιον* and elegiac epigram, to express these emotions, had been fixed by the same predecessors. Hellenistic lyric only surviving in meagre fragments, Catullus' originality appears greater here than in his elegiacs which we can compare with the epigrams of the Greek Anthology, but metre (especially the scazon iambic and phalaecan hendecasyllabic), subject-matter, and often phrasing indicate his obligations. The poems on Lesbia's sparrow (ii. and iii.) and that on the yacht (iv.) had Hellenistic prototypes, and an Alexandrian element crops up even in such an ardent love-poem as vii. (cf. ll. 3–6). Nevertheless it is in these shorter pieces that Catullus is most Roman and most himself. The attacks on the smaller fry who had incurred his displeasure often revolt us to-day by their gratuitous obscenity, but the *iambi* on Caesar and his associates, which recall but far surpass in bitterness the popular lampoons current at the expense of the *imperator unicus*, were justly considered by their chief victim to have branded him with *perpetua stigmata*. On the other side the Lesbia cycle cannot be paralleled in ancient literature for sincerity of passion, passing through all the stages of joyous contentment, growing distrust, and wild despair to the poignant adieu of the disillusioned lover.

The best edition of Catullus is that by W. Kroll (Leipzig, 1923). The best English commentary is that by R. Ellis (2nd ed., 1889). Neither the current Oxford text (1904) nor the Teubner (1923) can be considered satisfactory. Volume vi. of the Loeb Classical Library (1912) contains a text and translation of Catullus along with Tibullus and the *Pervigilium Veneris*. The most recent translations into English are by Sir William Marris (1924) and F. A. Wright (n.d.). See also H. A. J. Munro, *Criticisms and Elucidations of Catullus* (2nd ed., 1905); K. P. Harrington, *Catullus and his Influence* (1923); Frank Tenney, *Catullus and Horace* (1928). (E. A. B.)

**CATULUS**, the name of a distinguished family of ancient Rome of the gens Lutatia. The following are its most important members:

1. **GAIVS LUTATIVVS CATVLVS**, Roman commander during the first Punic War, consul 242 B.C. With a fleet of 200 ships, he occupied the harbours of Lilybaeum and Drepanum. The Carthaginian relieving fleet was totally defeated off the Aegates Islands, March 10, 241, and Catulus shared in the triumph, though, owing to a wound, he took no part in the operations. (See PUNIC WARS: First, *ad fin.*)

2. **QVINTVS LVTATIVVS CATVLVS**, Roman general and consul with Marius in 102 B.C. In the war against the Cimbri and Teutoni (*qq.v.*) he was sent to hold the passage of the Alps, but was forced back over the Po (see MARIUS, GAIVS). In 101 the Cimbri were defeated on the Raudine plain, near Vercellae, by the united armies of Catulus and Marius. The chief honour being ascribed to Marius, Catulus became his bitter opponent. He sided with Sulla in the civil war, was included in the proscription list of 87, and committed suicide. He was distinguished as an orator and writer, and is said to have written the history of his consulship and the

Cimbrian War. Two epigrams by him have been preserved and are published in W. W. Merry's *Fragments of Roman Poetry* (Oxford, 1898, p. 173). See Plutarch, *Marius, Sulla*; Appian, *B.C. i*, 74; Vell. Pat. ii, 21; Florus iii, 21; Val. Max. vi, 3, ix, 13; Cicero, *De Oratore*, iii, 3, 8; *Brutus*, 35.

3. QUINTUS LUTATIUS CATULUS (c. 120–61 B.C.), son of the above, was a consistent supporter of the aristocracy. In 78 he was consul with Marcus Aemilius Lepidus, who proposed the overthrow of the Sullan constitution. Catulus vigorously opposed this, but Lepidus marched on Rome at the head of an army. He was defeated by Catulus and Pompey and fled to Sardinia. In 67 and 66 Catulus unsuccessfully opposed the Gabinian and Manilian laws, which conferred special powers upon Pompey. He consistently opposed Caesar, whom he tried to implicate in the Catilinarian conspiracy. Caesar, in return, accused him of embezzling public money during the reconstruction of the temple on the Capitol. Catulus's supporters rallied round him, and Caesar dropped the charge. Although not a man of great abilities, Catulus exercised considerable influence through his political consistency and his undoubted solicitude for the welfare of the state.

See Sallust, *Catilina*, 35, 49; Dio Cassius xxxvi, 13; Plutarch, *Crassus*; Suetonius, *Caesar*, 15.

**CAUCA**, a department of Colombia, on the Pacific coast. Area 11,660 sq.mi. Pop. (1938 census) 356,040; (1951 est.) 468,790. The Western Cordillera, traversing nearly its whole length from south to north, and the Central Cordillera, forming a part of its eastern frontier, give a very mountainous character to the region. It includes, besides, the fertile and healthful valley of the upper Cauca, and a part of the coastal plain. The region is rich in mines and valuable forests, but its inhabitants have made very little progress in agriculture because there are not adequate transportation facilities. Capital of department is Popayán, pop. (1947) 35,960.

**CAUCASIAN AREA, NORTH.** A natural area and former province in the Russian Soviet Federated Socialist Republic. Boundaries are: W., the Ukraine, the Sea of Azov and the Black sea; S., the Azerbaijan and Georgian republics; E., the Caspian sea; N., the Stalingrad and Voronezh regions. Area, 110,969 sq.mi. Pop. 8,324,788; urban 1,408,085, rural 6,916,703. The following are linked to it administratively: the Kabarda-Balkaria, North Ossetian, Checheno-Ingushetia and Dagestan autonomous republics, and the Adyghe, Cherkess and Karachay autonomous regions. Most of the area is a fertile plain, which has always been a zone of movement of peoples, owing to its situation between the Black sea and the Caspian, with the Caucasus on its southern flank. It formed a link between the Mediterranean civilizations which established trading colonies there, the Persian and Turkish empires of Asia Minor, the Tatar and Mongol steppe peoples, and the Russians from the northwest, all attracted by its fertility and its trading possibilities. In 1926 the varying elements in the population included Russians (Great Russians, Ukrainians and White Russians) 83.38%, Chechens, 2.72%, Ossetians 2.03%, Armenians 1.98%, Kabardians 1.85%, Greeks 1.14%, Germans 1.06%, Cherkess 1.03%, with Ingushes, Karachayevs, Jews, Poles, Kalmucks, Georgians, Tatars, Turks, Persians, Moldavians, Estonians, Czechs and Leshians. In spite of these varied elements, the area has a certain economic unity: it is essentially an agricultural area undergoing a process of industrialization, and has an important export trade. In varying forms this export trade dates from a great antiquity. The west and southwest, with rich black earth soils, have intensive agriculture, market gardening and dairying, and a good net of communications; proximity of the Black sea and the Caucasus leads to increased rainfall and modification of summer heat and winter cold, abundance of streams and a longer vegetative period (*i.e.*, number of days with a temperature above 40° F.); in the Black sea area there are 275 days, and in Krasnodar, Maikop and Armavir 250, as against 200–210 days in the Donetsk and Shakhtinsk areas. Towards the north and in the east the climatic influences are continental, with drought conditions, and in the east the soils are chestnut-coloured (favourable to the growth of summer wheat in wet years), with about 10% saline and arid sands unfit for agriculture. The chief crops are summer wheat in the northern provinces, a hard variety

in demand on the world market for flour and macaroni, etc., winter wheat in the wetter southwest districts, barley, maize, rye, millet and oats. Sunflower seed, providing food, oil, fuel and potash is increasingly cultivated in the Kuban area, as are crops new to the region such as cotton, soybeans, castor-oil plants and kenaf. Swampy tracts along the Kuban are being reclaimed and sown to rice, a crop also new to the region. There are vineyards in the Don, Black sea, Kuban and Terek areas: the Don wines are good, but the Kuban and Terek wine is sharp. Vineyards are being extended in the sandy areas along the Don. Tobacco is cultivated in the Kuban and Black sea regions. In the southwest Kuban and near the great cities and health resorts market gardening (especially of melons, pumpkins and potatoes) is prosperous. Agriculture suffered severely during World War I and was slowly recovering during the post-World War I years.

Cattle rearing is decreasing, and is mainly limited to the dry steppe and the hill pasture meadows. The stock of horses greatly diminished between 1914 and 1921. Horses are bred in Kuban and Kabardia and by the steppe nomads. In Kuban they are used as working animals. The gray Black sea cattle, related to the Ukrainian cattle, are the best working oxen, and are bred and used in the north and near Maikop. Dairy cattle (German) are in demand near the cities, while the Kalmucks breed the best cattle for meat. Formerly in the Stavropol steppe and the Salsk area there were 4,000,000 head of merino sheep, but they were catastrophically destroyed between 1914–21 and the number dropped to only 300,000 or 400,000. Goats are kept for milking, especially in the hill areas. Pig breeding recovered its pre-World War I level, especially in the Kuban and the maize zone of the foothills. Hens, geese, ducks and turkeys numbered 11,000,000 before World War II, and eggs, feathers, down and live and dead birds are exported (mainly to the home Russian markets). In Kuban, Terek and the foothills the long, warm summer and the flora favour beekeeping, and much good wax is exported.

The steppe and much of the plain is treeless, except near the streams and along the Don valley (oak and elm). On the foothills patches of mixed steppe and forest lead to the continuous beech, oak, hornbeam, ash, maple, lime and elm forest, above which are pines, birches and silver firs, with Alpine meadows higher still. The Black sea slopes yield yew and chestnut. The government is controlling timber felling on the foothills in view of the importance of tree growth in regulating the streams and in fixing the soil. In the higher regions much timber is neglected because of lack of labour and lack of transport. Of the timber, most goes to the treeless steppe, the markets of the near east and the Mediterranean. The silver fir is used in the home region for cellulose manufacture.

Fishing for bream, carp, herring, mackerel, sturgeon and anchovy is carried on in a primitive way, but suffers from lack of refrigerators and of quick transport. The mineral wealth consists of the Grozny and Maikop-Taman naphtha beds, the silver, lead and zinc ores of Alagir, south of Orjonikidze, lead ore on the upper Kuban, anthracite in the Shakhtinsk area and south of Batalpashinsk, and coal and iron ore on the north shore of Azov. Some of the mines are worked by peasant artels. The chief manufactures are foodstuffs (flour and fish, fruit and vegetable preserves) especially in the Kuban, naphtha refining at Grozny, Tuapse, Maikop (aviation benzine), cement at Novorossiysk, tobacco at Rostov, Krasnodar, Armavir and Orjonikidze, agricultural machinery at Rostov, Taganrog and Sylin, leather at Taganrog and Maikop, sugar near Armavir and in the Kuban. Maize products (brandy, starch and flour), textiles (wool, cotton, stockings, ropes), soap, potash, bricks, glass, tiles and paper are also manufactured and there are printing works at Rostov and other towns. Side by side with the factory industries go the koustar (peasant) industries and in the flour milling and oil pressing they produce 45% of the total. The chief towns in order of size of population in 1939 are: Rostov-on-Don 510,253; Krasnodar 203,946; Taganrog, Grozny, Shakhty, Orjonikidze (Vladikavkaz), Novorossiysk, Armavir, Maikop, Voroshilovsk, Pyatigorsk, all over 50,000; and Batalpashinsk, Millerop and Salsk.

These towns and their population are an indication of the



marked industrial development of the area, as is the fact that naphtha and not wheat is now the chief export. But agriculture is still, as in the past, the chief occupation of the area. In the internal life of the area it affects directly the welfare of four-fifths of the population and indirectly its development affects the remaining one-fifth, regulating markets, causing seasonal overfreightage of the transport network (railways, ports, elevators and refrigerators) and supplying the raw material for the factories and the food for the workers. The importance of the North Caucasian area in the economy of the U.S.S.R. as a source of supply of wheat and raw material is recognized by the government.

A canal was being constructed in 1941 to transfer part of the waters of the Kuban, which has an oversupply, to the Manich, a tributary of the lower Don. This canal was to irrigate 2,500,000 ac. of land. Eventually the Manich waterway will be extended to the Caspian sea, 390 mi. away. Its level will be maintained by a canal from the Terek which will also generate water power and irrigate a large expanse of steppe land.

**CAUCASIAN LANGUAGES.** This term is applied to the languages used on the Caucasian isthmus which do not belong to the Indo-German, or to the Semitic, or to the Turco-Mongolian family. They are divided into three groups—the *East Caucasian*, the *West Caucasian* and the *South Caucasian*. The East Caucasian group can be divided into eight branches: 1. The Chechen branch (the chief being the Chechen language of the middle course of the Terek and Daghestan); 2. Avaro-Andi (12 languages in West Daghestan, the chief being the Avar language); 3. Darghi (East Daghestan); 4. Samur (South Daghestan, the chief being the Kuri language, near Derbent); 5. Lakk or Kasi-Kumuk (Central Daghestan); 6. Artchi (one village in Central Daghestan); 7. Hinalugh (one village near the mountain Shah-Dag); and 8. Udi (two villages near the town Nukha). The West Caucasian languages have three branches: 1. Abkhaz—region of Sukhum-Kale; 2. Ubykh—formerly dominant in the region of Sochi, but now spoken only by a few families in Asia Minor; 3. Adyghe, with two dialects—Kabardi (in the so-called Kabarda, principal town Naltchik) and Kiakh or Cherkess (region of Kuban and the Caucasian shore of the Black sea). The South Caucasian languages are: 1. Georgian with its dialects; 2. Mingrelian and Laz; 3. Svanetian.

East Caucasian and West Caucasian are related and may be considered as two branches of the North Caucasian group. The relationship between this and the South Caucasian group has not, as yet, been scientifically proved, and in the present state of our knowledge the North Caucasian and South Caucasian groups must be considered as separate.

The North Caucasian languages are distinguished by an extraordinary abundance of *consonants*, which in Cherkess are 57 in number. Very characteristic of the phonetic system of North Caucasian languages are the lateral consonants, which convey the impression of combinations *kl, gl, thl*; then a great number of consonants of the type *k*, pronounced in the deep back part of the palate, etc. This superabundance of consonants is moderated in the East Caucasian group where consonants rarely come into contact with each other; but in West Caucasian languages the contact and combination of consonants occur very frequently, and the most complicated combinations, very difficult to pronounce, are admitted.

In the East Caucasian languages substantives are divided into classes or "genders"; their number varies in different languages (from two to six). In most cases, neither from the meaning of the word nor from any outward formal symptom is it possible to know to which class the substantive belongs. Very often the same substantive belongs in the singular to one class and in the plural to another. A consonant, specific for each group (*w, b, d, r, y*) is added as prefix, infix or suffix to the adjectives, verbs, pronouns, adverbs, etc., connected with the substantive. For example, the Avars say: "*Dow tchi wugo roqow*"—this man is in the house; "*Dob keto bugo roqob*"—this cat is in the house; "*Doy thladi Yigo roqoy*"—this wife is in the house. Substantives, adjectives and pronouns are declined; an extraordinary number of cases is used to express ideas that in other languages are expressed by

a combination of words with prepositions. The Tabassaran language has 35 cases. The system of declension is based on the opposition of *Casus Agens* to *Casus Patiens*. The *Casus Agens* is used for the logical subject of transitive verbs, and *Casus Patiens* for the logical object of transitive and logical subject of intransitive verbs. The outward distinction between *Casus Agens* and *Casus Patiens* is expressed in a different way by different substantives. Thus, in the Kuri language *Lam*—"ass"—has *Agens Lamra* and *ghum*—"smoke"—has *Agens ghumadi*. All other cases are derived from the *Agens* by adding different endings. The plural is also formed differently from different substantives, so that the declension of substantives in East Caucasian languages is full of irregularities. The same is true of conjugation in most of these languages. The verbal root, *i.e.*, the invariable part of all verbal forms, consists mostly of one consonant. Before it are the prefixes, indicating the aspect of the verb (*i.e.*, whether the action is considered as a lasting process or as a concluded action) and the gender signs mentioned above agree with the *Patiens* of the sentence. After the root consonant come the elements, indicating time, mood and sometimes the person. There are many verbal forms and the difference of their meaning is often very subtle and difficult to define. The East Caucasian languages have therefore a complicated grammar with a great abundance and prodigality of forms. The same prodigality is found in the vocabulary; there are for instance special adverbs to indicate such notions as "five years ago," "four days later," etc.—these words having nothing in common with the corresponding numerals.

In the West Caucasian languages, declension is reduced to a minimum; the Adyghe and Ubykh languages have only three cases, the Abkhaz has no declension at all. There are fewer verbal forms than in the East Caucasian languages. The vocabulary is poor, so that the simplest notions are expressed by compound words, *e.g.*, in Adyghe the beard is designated as "tail of the mouth," etc. The characteristic peculiarity of West Caucasian languages is a fondness for combining words. Notwithstanding these differences between East and West Caucasian languages, there are still important similarities in both these groups—*viz.*, in the most elementary words, personal pronouns, numerals, simple verb roots, etc., so that there can be no doubt as to their relationship. There are also isolated similarities in the grammar, for instance the opposition of *Casus Agens* to *Casus Patiens*, traces of the different classes of substantives, etc.

The phonetic system of South Caucasian languages is simpler than that of the North Caucasian; there is a striking fondness for the agglomeration of consonants (*e.g.*, the Georgian, *mghwdl* is genit. for "priest"). There is only one gender. The declension is rich in case forms, but their formation is regular. The verb has a developed conjugation; the means of expressing personal forms through combination of certain prefixes and suffixes is complicated. In the South Caucasian languages the agreement of the verb with its subject and object varies with the tenses of the verb. In the present the subject is in the nominative and the object in the dative-accusative. In the Aorist the subject is in a special case (*Agens*?) and the object in the nominative, in the perfect the subject is in the dative and the object in the nominative.

Georgian alone has an ancient written literature, beginning with the 5th century A.D., and in recent years books and newspapers have begun to appear in other Caucasian languages.

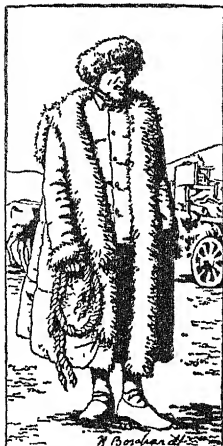
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**CAUCASUS**, a mountain range, stretching north-west to south-east from the Strait of Kerch (between the Black sea and Sea of Azov) to the Caspian sea, over 900m. long and varying from 30 to 140m. in width. In its general uniformity of direction, its comparatively narrow width, and its well-defined limits towards both south and north, it presents a closer analogy with the Pyrenees than with the Alps. The range, like the Pyrenees, maintains for considerable distances a high elevation, and is not cleft by

natural passes, as in the Alps. In both ranges some of the highest summits stand on spurs of the main range, not on the main range itself, e.g., Mts Elbruz and Kasbek, Dykh-tau, Koshtan-tau, Janga-tau and Shkara. For purposes of description it is convenient to consider the range in four sections, a western, a middle with two subsections and an eastern.

**Western Caucasus.**—This section, extending from the Strait of Kerch to Mt. Elbruz in  $42^{\circ} 40'$  E., is over 420m. long, and runs parallel to the north-east coast of the Black sea and only a short distance from it. Between the main range and the sea there intervene at least two parallel ranges separated by deep glens, and behind it a third subsidiary parallel range, likewise separated by a deep valley, and known as the Bokovoi Khrebet. All these ranges are crossed by numerous glens and gorges, and the rainfall being heavy and the exposure favourable, they are densely clothed with vegetation. Many of the spurs abut steeply upon the Black sea, so that this littoral region is very rugged and not readily accessible. The seaward flanking ranges run up to 4,000ft. and more, and in many places form cliffs which overhang the coast some 2,000–3,000ft., while the main range gradually ascends to 10,000–12,000ft. as it advances east, the principal peaks being Fisht (8,040ft.), Oshten (9,210ft.), Shuguz (10,640ft.), and Psysh (12,425ft.). The main range is built up of hard crystalline rocks, and the subsidiary chains are composed of softer strata (Cretaceous and Tertiary) which are more easily disintegrated. The snowline is about 9,000ft. on the loftiest summits, and east of Oshten the crest of the main range is capped with perpetual snow and carries many hanging glaciers, while larger glaciers creep down the principal valleys. The few passes lie at relatively great altitudes, so that although the northern versants of the various ranges all have a gentle slope, communication between the Black sea and the valley of the Kuban, and the low steppe country beyond, is not easy. The more important passes, proceeding from west to east are Pshekh (5,435ft.), and Shetlib (6,060ft.), Pseashka (6,880ft.), Sanchar (7,990ft.); between the last-named and Elbruz are the passes of Marukh (11,500ft.), Klukhor (9,450ft.) and Nakhar (9,615ft.).

Owing to topographical and climatic conditions the southern exposure fosters a luxuriant and abundant vegetation. The most distinguishing feature of the flora is the predominance of arborescent growths; forests cover 56% of the area and are not only dense but laced together with climbing and twining plants. The commonest species of trees are such as grow in central Europe, viz, ash, fir, pine, beech, acacia, maple, birch, box, chestnut, laurel, holm-oak, poplar, elm, lime, yew, elder, willow, oak. The common box is especially prevalent, but the preponderating species are *Coniferae*, including the Caucasian species *Pinus halepensis* and *P. insignis*. The commonest firs are *Abies nordmannia* and *A. orientalis*. There are two native oaks, *Quercus ponticus* and *Q. sessiliflora*. A great variety of shrubs grow on these slopes of the western Caucasus, chiefly the following species, several of which are indigenous—*Rhododendron ponticum*, *Azalea pontica*, *Aristotelia maqui*, *Agave americana*, *Cephalaria tatarica*, *Cotoneaster pyracantha*, *Citrus aurantium*, *Diospyros ebumum*, *Ficus carica*, *Illicium anisatum*, *Ligustrum caucasicum*, *Punica granatum*, *Philadelphus coronarius*, *Pyrus salicifolia*, *Rhus cotinus* and six species of *Viburnum*. A great variety of aquatic plants thrive excellently. The following purely Caucasian species also grow on the coast—five species of spearwort, three of saxifrage, *Aster caucasicus*, *Dioscorea caucasicus*, *Echinops raddeanus*, *Hedera colchica*, *Helleborus caucasicus* and *Peucedanum caucasicum*. Here too are found magnolia, azalea, camellia, begonia and paulownia. Among the cultivated trees and shrubs the most valuable are the vine, peach, pomegranate, fig, olive (up to 1,500ft. above sea-level), chestnut, apricot, apple, pear, plum, cherry, melon, tea (on the coast



BY COURTESY OF NEAR EAST  
RELIEF  
NATIVE OF THE CAUCASUS

between Sukhum-Kaleh and Batumi), maize (yielding the staple food of the inhabitants), wheat (up to 6,000ft.), potatoes, peas, currants, cotton, rice, colza and tobacco. After the Russian conquest half a million of the inhabitants of this region being Mohammedans, and refusing to submit to the yoke of Christian Russia, emigrated into Turkish territory, and the country where they had lived remained for the most part unoccupied until after the beginning of the 20th century. The coast-line is remarkably regular, there being no deep bays and few seaports. The best accommodation that these latter afford consists of more or less open roadsteads, e.g., Novorossiisk, Gelenjik, Anapa, Sukhum-Kaleh, Poti and Batumi. Along the coast are summer bathing resorts similar to those of the south-east coast of the Crimea. The largest are Anapa, Gelenjik and Gagry.

**Middle Caucasus: (a) Western Half.**—This sub-section, having a length of 200m., reaches from Mt. Elbruz to Kasbek and the Pass of Darial. It contains the loftiest peaks of the whole range, of which those above 15,000ft. are.—Elbruz (west peak) 18,465ft. and (east peak) 18,345ft., Jaikyl 17,780ft., Dykh-tau 17,050ft., Shkara 17,040ft., Koshtan-tau 16,875ft., Janga-tau 16,660ft. (west peak) and 16,525ft. (east peak), Kasbek 16,545ft., Mishirghi-tau 16,410ft. (west peak) and 16,350ft. (east peak), Adish or Katuyntau 16,295ft., Gestola 15,940ft., Tetnuld 15,920ft., Gimairai-Khokh 15,670ft., Ushba 15,410ft. (south-west peak) and 15,400ft. (north-east peak), Ullu-az 15,350ft., Adai-Khokh 15,275ft., Tikhtengen 15,135ft., Tiutiun-tau 15,115ft.

The crest of the main range runs at an altitude exceeding 10,000ft., but is surpassed in elevation by the secondary range to the north, the Bokovoi Khrebet. These ranges are connected by more than half a dozen short transverse spurs enclosing as many cirques. Besides the Bokovoi Khrebet several other short subsidiary ranges branch off from the main range at acute angles, with high glens between them. Down all these glens glacier streams descend, until they find an opportunity to pierce through the flanking ranges, which they do in deep gorges, and then race down the northern slopes of the mountains to enter the Terek or the Kuban, or down the southern versant to join the Rion or the Kura. Amongst all these high glens there is a remarkable absence of lakes and waterfalls; nor are there down in the lower valleys, as one would expect in a region so extensively glaciated, any sheets of water corresponding to the Swiss lakes. In this section of the Caucasus the loftiest peaks do not as a rule rise on the main range, but in many cases on the short spurs that link it with the Bokovoi Khrebet and other subsidiary ranges.

**Glaciers.**—The snow-line runs at 9,500 to 10,000ft. on the northern face and 1,000ft. higher on the southern face. There are over 900 glaciers in this section, and although they often rival those of the Alps in size, they do not descend generally to such low altitudes. The best known are the Bezingi or Ullu, between Dykh-tau and Janga-tau, 10½m. long, and descending to 6,535ft. above sea-level; Leksyr, situated south of Adyr-su-bashi, 7½m. long, and its end at 5,690ft., the lowest point to which any glacier descends on the south side of the range; Tseyra or Zeyra, descending 6m. from the Adai-khokh to 6,730ft.; Karagom, from the same mountain, 9½m. long, and reaching down to 5,790ft., the lowest on the northern side; Dyevdorak or Devdorak, from Kasbek, 2½m. long, its end at 7,530ft.; Khaldeh or Geresho 4½m. long, from Shkara and Janga-tau; Tuyber from Tetnuld, 6½m. long, and reaching down to 6,565ft.; Tsanner or Zanner, the same length, but stopping short 240ft. higher, likewise given off by Tetnuld; while between that peak, Adish and Gestola originates the Adish or Lardkhat glacier, 5m. long and terminating at 7,450ft. The total area covered by glaciers in the central Caucasus is estimated at 625 to 650sq m., the longest being the Maliev on Kasbek, 36m. long; but according to M. Rossikov several of the largest glaciers are retreating, the Tseyra at the rate of something like 40–45ft. per annum.

**Passes.**—It is in this section that the mountain system is narrowest, and here (apart from the "gate" at Derbent close beside the Caspian) are the principal north to south communications, between south Russia and Armenia and Asia Minor. These are the passes of Darial and Mamison. Over the former, which lies

immediately east of Kasbek, runs the Georgian military road (1811-64) from Vladikavkaz to Tiflis, cutting through the mountains by a beautiful gorge (8m. long), shut in by mountain walls nearly 6,000ft. high, and so narrow that there is only just room for the road and the river Terek side by side. The pass by which this road crosses the main range farther south is known as the Krestovaya Gora and lies 7,805ft. above sea-level. The Mamison pass, over which runs the Ossetic military road (made passable for vehicles in 1889) from the Terek (below Vladikavkaz) to Kutais in the valley of the Rion, skirting the eastern foot of the Adai-khokh, lies at an altitude of 9,270ft. and is situated a little south of the main range. Horses can traverse only the best of the other passes and only during a few weeks in summer. They range at altitudes of 9,000-12,500ft., and between the pass of Nakhar in the west and that of Mamison in the east there is not a pass below 10,000ft. The best known are Chiper (10,800-10,720ft.), Bassa (9,950ft.), Donguz-orun (10,490ft.), Becho (11,070ft.), Akh-su (12,465ft.), Bak (10,220ft.), Adyr-su (12,305ft.), Bezingi (10,090ft.), Shari-vizk (11,560ft.), Edena, Pasis-mta or Godivizk (11,270ft.), Shtulu-vizk (10,860ft.), Fytnargyn (11,130ft.), Bakh-fandak (9,570ft.), the two Karaul passes (11,680 and 11,270ft.) and Gurdzi-vizk (10,970ft.). The most frequented pass in Svanetia is that of Latpari (9,260ft.), situated in the first of the southern subsidiary ranges mentioned above, and thus connecting the valleys of the Ingur and the Tskhenis-Tskhali.

**Flora.**—In this section of the range again the southern slopes are clothed with vegetation of remarkable luxuriance and richness, more especially in the region of Svanetia ( $42^{\circ}$ - $43^{\circ}$  E.). Here again the plants are bigger and the blossoms more abundant than in the Alps, forests of *Coniferae* predominate, and gigantic male ferns (*Aspidium filix-mas*), *Paris incompleta* (a member of the Trilliaceae), *Usnea* or tree-moss, box, holly (*Ilex aquifolium*), *Lilium monadelphum* and many of the herbaceous plants which flower in English gardens, grow here to an extraordinary size—monkshoods, *Cephalaria*, *Mulgedia* and groundsel. Other species are *Campanula*, *Pyrethrum*, aconite, *Cephaelis*, speedwell, *Alchemilla sericea*, *Centaurea macrocephala*, *Primula grandis* and a species of primrose. Flowers of great beauty and abundance blossom up to 13,000ft. on the northern slope and on the southern slope ascend 2,000ft. higher. Walnuts grow up to an altitude of 5,400ft., the vine and mulberry to 3,250ft., the lime and ash to 4,000ft. The forests extend to the upper end of the limestone gorges. Above that the crystalline schists are bare of tree vegetation. The upper limit of arborescent vegetation is 7,000-7,500ft., of shrubs, e.g., rhododendrons, 8,500ft., and of pasture-lands up to 9,000ft. The principal cultivated varieties of plants in this section are wheat, rye, oats, barley, beans, millet and tobacco.

**Middle Caucasus: (b) Eastern Part.**—In this sub-section, which stretches from Kasbek and the Darial gorge to the Baba-dagh in  $48^{\circ} 25'$  E., a distance of 230m., the Caucasus attains its greatest breadth. For the whole distance the main range keeps an average elevation of 10,000ft., though the peaks are 2,000 to nearly 5,000ft. higher, the altitudes increasing towards the east. The glaciers decrease in the same proportion. Here the principal peaks, again found chiefly on the spurs and subsidiary ranges, are the Tsmiakom-khokh (13,570ft.), Shan-tau (14,530ft.), Kidenais-magali (13,840ft.), Zilga-khokh (12,645ft.), Zikari (12,565ft.), Choukhi (12,110ft.), Julti-dagh (12,430ft.), Alakhun-dagh (12,690ft.) and Maghi-dagh (12,445ft.). On the main range stand Borballo (10,175ft.), Great Shavi-kildeh (12,325ft.), Murov (11,110ft.), Ansal (11,740ft.), Ginor-roso (11,120ft.), while farther east come Trfan-dagh (13,765ft.) and Bazardyuz or Kichen (14,727ft.). In the same direction, but again outside the main range, lie Shah-dagh (13,955ft.), Shalbuz (13,675ft.) and Malkamud (12,750ft.).

\* The most noteworthy feature of this section is the broad highland region of Daghestan, which flanks the main range on the north and sinks down to the Caspian sea (east), and to the valley of the Terek (north). On the north-west this rugged highland region is well defined by the transverse ridge of Andi, which to the east of Kasbek strikes off from the Caucasus range almost at right angles. The rest of the Daghestan region consists of a series of roughly

parallel folds, of Jurassic age, ranging in altitudes from 7,500 up to 12,500ft., separated by deep river glens which cut it up into a number of arid, treeless plateaus. The most prominent of these tablelands is Bash-lam, which stretches east and west between the Chanti Argun and the Andian Koisu. Upon it rise the conspicuous peaks of Tebulos-mta (14,775ft.), Tugo-mta (13,795ft.), Komitotavi or Kachu (14,010ft.), Donos-mta (13,560ft.), Diklos-mta (13,740ft.), Kvavlos-mta or Kolos-mta (13,080ft.), Motshekh-tsferi (13,140ft.) and Galavanas-tsferi (13,260ft.). Farther east is the Bogos tableland, stretching from south-south-west to east-north-east between the Andian Koisu and the Avarian Koisu and rising to over 13,400ft. in several peaks, e.g., Antshovala (13,440ft.), Botshokh-meër (13,515ft.), Kosara-ku (13,420ft.) and Addala-shuogchol-meër (13,580ft.); and the Dyulty tableland reaching 12,400ft. between the Kara Koisu and the Kazikumukh Koisu. Névé and glaciers occur on some of these peaks, particularly on the slopes of Diklos-mta, where the glaciers descend to 7,700ft. (north) and to 8,350ft. (south). Here the passes are lower than those between Elbruz and Kasbek, though at appreciable heights, fully equal to those that lead up from the Black sea to the valley of the Kubañ in the western section of the range. The best known are the Krestovaya Gora (7,805ft.) on the Georgian military road south of Darial; Kodor (9,300ft.) and Satskheni, and Gudur (10,120ft.) and Salavat (9,280ft.), carrying the Akhty military road.

The flora of this section bears a general resemblance to that farther west. Ample details will be found in Dr. G. Radde's (1831-1903) monographs on Daghestan.

**Eastern Caucasus.**—This section of the Caucasus gradually dies away east of Baba-dagh (11,930ft.) towards the Caspian, terminating finally in the peninsula of Apsheron. It is, however, continued under the waters of the Caspian and reappears on its eastern side in the Kopet-dagh, which skirts the north-eastern frontier of Persia. In this section of the Caucasus no peak exceeds 9,000ft. in altitude and the crest of the main range retains no snow. The most frequented pass is Alty-agach (4,355ft.).

Between the northern and the southern sides of the range there is a great difference in climate, productions and scenery. In the south-western slopes and valleys where a heavy rainfall is combined with a warm temperature, magnificent forests clothe the mountain-sides and reach the waters of the Black sea. There the littoral from, say, Sukhum-kaleh to Batum, and the inland parts of the basin of the Rion, will bear comparison with any of the provinces of Italy in richness and variety of products. But farther inland, east of Tiflis, a great change becomes noticeable on the other side of the transverse ridge of the Suram or Meskes mountains. Arid upland plains and parched hillsides take the place of the rich verdure and luxuriant arborescent growth of Imeretia, Svanetia and Mingrelia, the districts which occupy the valleys of the Ingur and Rion and the tributaries of the latter. A very similar change likewise becomes noticeable in the higher regions of the Caucasus mountains north of the pass of Mamison. The valleys of the Rion and Ardon and of others that flow in the same direction, are almost wholly destitute of trees, but where the bare rock does not prevail, the mountain slopes are carpeted with grass. "Treeless valleys, bold rocks, slopes of forbidding steepness (even to eyes accustomed to those of the Alps), and stone-built villages, scarcely distinguishable from the neighbouring crags" (Freshfield). Austere and unattractive though those valleys are, the same epithets cannot be applied to the deep gorges by which in most cases the streams make their escape through the northern subsidiary range. These defiles are declared to be superior in grandeur to anything of the kind in the Alps. That of Darial (the Terek) is fairly well known, but those of the Cherek and the Uruk, farther west, are stated to be still more magnificent. Not only do the snow-clad ranges and the ice-panoplied peaks surpass the loftiest summits of the Alps in altitude; they also in many cases excel them in boldness and picturesqueness of outline, and equal the most difficult of them in steepness and relative inaccessibility.

**Hydrography.**—Nearly all the larger rivers of Caucasia have their sources in the central parts of the Caucasus range. The torrential streams of Mdzimta, Pzou, Bzyb and Kodor drain the



country west of Elbruz. The Ingur, Tskhenis-Tskhali, Rion and its tributaries, *e.g.*, the Kvirila, are longer but also in part torrential; they drain the great glacier region between Elbruz and Kasbek. The Rion is the *Phasis* of the ancients and flows through the classic land of Colchis. The Lyakhva and Aragva, tributaries of the Kura, carry off the waters of the main range south of Kasbek, and other tributaries, such as the Yora and the Alazan, collect the surplus drainage of the main Caucasus range farther east. The other large river of this region, the Aras, has its sources, not in the Caucasus range, but on the Armenian highlands a long way south-west of Ararat. The rivers which go down northwards from the central Caucasus have longer courses than those on the south. The most important of these are the Kubañ and the Terek; most of the streams which have their sources among the central glaciers draining into the latter, *e.g.*, the Malka, Baksan, Chegem, Cherek, Uruk, Ardon. The Kuma, which alone pursues an independent course through the steppes, farther north than the Terek, has its sources, not in the main ranges of the Caucasus, but in a group of mountains near Pyatigorsk. Its waters become absorbed in the sands of the desert steppes before they reach the Caspian. Of the streams that carve into chequers the elevated plateau of Daghestan, four, known by the common name of the Koisu, unite to form the Sulak. The only other stream deserving of mention in this province is the Samur. Both rivers discharge their waters into the Caspian, as also does the Zumgail, a small stream which drains the eastern extremity of the Caucasus range.

**Volcanic Evidences.**—Ancient but now extinct volcanic centres occur frequently at the intersections of the main range with the transverse ranges; of these the most noteworthy are Elbruz and Kasbek. The town of Shemakha near the eastern end of the system was the scene of volcanic outbreaks as late as 1859, 1872 and 1902; while in the adjacent peninsula of Apsheron mud volcanoes exist in large numbers. All along the northern foot of the system hot mineral springs gush out at various places, such as Pyatigorsk, Zhelesnovodsk, Essentuki and Kislovodsk; and the series is continued along the north-eastern foot of the highlands of Daghestan, *e.g.*, Isti-su, Eskiendery, Akhta. Also similar evidences of volcanic activity characterize the northern border of the Armenian highlands on the southern side of the Rion-Kura depression, in the mountains of Ararat, Alagöz, Akmangan, Samsar, Godoreby, Great and Little Abull, and in the mineral springs of Borzhom, Abbas-tuman, Sleptzov, Mikhailovsk and Tiflis.

**Geology.**—The structure of the Caucasus is comparatively simple, and in the form of a fan. In the centre are crystalline rocks which disappear towards the east. Beneath them, on both sides, plunge the strongly folded Palaeozoic and Jurassic schists. On the north the folded beds are followed by a zone of Jurassic and Cretaceous beds which rapidly assume a gentle inclination towards the plain. On the south the corresponding zone is affected by numerous secondary folds which involve Upper Miocene deposits. In the east, the structure is somewhat modified. The crystalline band is lost. The northern Mesozoic zone is very much broader, and is thrown into simple folds like those of the Jura mountains. The Mesozoic zone is absent in the south, and the Palaeozoic zone sinks abruptly in a series of faulted steps to the plain of the Kura, beneath which no doubt the continuation of the Mesozoic zone is concealed.

The geological sequence begins with the granite and schists of the central zone, which extend from Fisht (west) to some distance beyond Kasbek (east). Then follow the Palaeozoic schists and slates. Fossils are extremely rare in these beds; *Buthotrephis* has long been known, and traces of *Calamites* and ferns, and in the west fossils which appear to indicate a Devonian age. Upon the Palaeozoic rest Mesozoic deposits (Lias to Upper Cretaceous). Different views exist as to the position of unconformities, but important ones occur at the base of the Tithonian (Upper Jurassic) and at the base of the Trias. In general the Upper Jurassic beds are much more calcareous on the north than they are on the south. The Mesozoic are followed by Tertiary deposits, which on the north are nearly horizontal but on the south are in part included in the folds—the Eocene and Miocene being folded, while later beds, though sometimes elevated, may not be affected

by the folding. The final folding of the chain, proceeding from north-east, undoubtedly occurred at the end of the Miocene period. Folding also occurred probably during the Permian and again during the Upper Jurassic (direction south-west). Also the difference in character of the Jurassic beds on the two sides of the chain appears to indicate that a ridge existed in that period. The last phase in the history of the Caucasus was the growth of the great volcanoes of Elbruz and Kasbek, which stand upon the old rocks of the central zone, and by the outflow of sheets of lava upon the sides of the chain. The cones are composed largely of acid andesites, but many of the lavas are augite andesites and basalts. There seem to have been two periods of eruption, and as some of the lavas have flowed over Quaternary gravels, the latest outbursts must have been of very recent date.

Near the northern foot of the Caucasus, especially near the hot mineral springs of Pyatigorsk, a group of igneous rocks rises above the plain. They are laccolites of trachytic rock, and raised the Tertiary beds above them in the form of blisters. Subsequent denudation has removed the sedimentary covering and exposed the igneous core. Petroleum occurs in the Tertiary beds at both ends of the chain.

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## HISTORY

To the ancient Greeks Caucasia, and the mighty range which dominates it, were a region of mystery and romance. It was there that they placed the scene of the sufferings of Prometheus (*vide* Aeschylus, *Prometheus Vincit*), and there, in the land of Colchis, which corresponds to the valley of the Rion, that they sent the Argonauts to fetch the golden fleece. Outside the domain of myth, the earliest connection of the Greeks with Caucasia would appear to have been through the maritime colonies, such as Dioscurias, which the Milesians founded on the Black sea coast in the 7th century B.C. For more than two thousand years the most powerful state in Caucasia was that of Georgia (*q.v.*). The southern portion of Transcaucasia fell during the 1st century B.C. under the sway of Armenia, and with that country passed under the dominion of Rome, and so eventually of the Eastern empire. During the 3rd century A.D. Georgia and Armenia were invaded and in great part occupied by the Khazars, and then for more than a thousand years the mountain fastnesses of this borderland between Europe and Asia were the refuge, or the resting-place, of successive waves of migration. The Huns and the Avars appeared in the 6th century, and the Mongols in the 13th. In the 10th century bands of Varangians or Russified Scandinavians sailed out of the Volga and coasted along the Caspian until they had doubled the Apsheron peninsula, when they landed and captured Barda, the chief town of Caucasian Albania.

But, apart from Georgia, historical interest in Caucasia centres in the long and persistent attempts which the Russians made to conquer it, and the heroic, though unavailing, resistance offered by the mountain races, more especially the Circassian and Lesghian tribes. Russian aggression began early in the 18th cen-

tury, when Peter the Great, establishing his base at Astrakhan on the Volga, and using the Caspian for bringing up supplies and munitions of war, captured Derbent from the Persians in 1722, and Baku in 1723. But these conquests, with others made at the expense of Persia, were restored to the latter power after Peter's death, a dozen years later. At that period the Georgians were divided into various petty principalities, the chief of which were Imeretia and Georgia (Kharthlia), owing at times a more or less shadowy allegiance to the Ottoman sultan. In 1770, when at war with Turkey, the Russians crossed over the Caucasus and assisted the Imeretians to resist the Turks, and from the time of the ensuing peace of Kuchuk-kainarji the Georgian principalities looked to Russia as their protector against the Turks. In 1783 George XIII., prince of Georgia and Mingrelia, formally put himself under the suzerainty of Russia, and after his death Georgia was converted (1801) into a Russian province. The same fate overtook Imeretia nine years later. Meanwhile the Russians had also subdued the Ossetes (1802) and the Lesghian tribes (1803) of the middle Caucasus. By the peace of Gulistan in 1813 Persia ceded to Russia several districts in Eastern Caucasia, from Lenkoran northwards to Derbent. Nevertheless the mountain tribes were still independent, and their subjugation cost Russia a sustained effort of thirty years. At first the Russians were able to continue their policy of conquest and annexation without serious check. After acquiring the northern edge of the Armenian plateau, partly from Persia in 1828 and partly from Turkey in 1829, Russia in 1832 crushed a rising in Daghestan. The next seven years were occupied with the subjugation of the Abkhassians along the Black sea coast, and of other Circassian tribes in the west. Meanwhile Shamyl, a chief and religious leader of the Lesghians, had roused the Lesghian tribes farther east. His resistance was finally broken after 20 years of warfare by Prince Baryatinsky, who succeeded in capturing Shamyl's stronghold of Weden, and then in surrounding and capturing (1859) that chieftain himself on the inaccessible rocky platform of Gunib in the heart of Daghestan. But it was not until 1864 that the Russians finally stifled all opposition. Then followed a wholesale emigration of the Circassians, who sought an asylum in Turkish territory, leaving their native region almost uninhabited and desolate. During the Russo-Turkish War of 1877-78 the self-exiled Circassians and other Caucasian mountaineers, supported by a force of 14,000 Turks, made a determined attempt to wrest their native glens from the power of Russia; but, after suffering a severe defeat at the hands of General Alkhazov, the Turks withdrew, and were accompanied by some 30,000 Abkhassians, who settled in Asia Minor. A few months later the Lesghians in Daghestan, who had risen in revolt, were defeated and their country once more reduced to obedience. By the peace of Adrianople, Russia still further enlarged her Transcaucasian territories by the acquisition of the districts of Kars, Batum and Ardahan. After a peaceful period of a quarter of a century the Armenian subjects of Russia in Transcaucasia were filled with bitterness and discontent by the confiscation of the properties of their national (Gregorian) Church by the Russian treasury. Nor were their feelings more than half allayed by the arrangement which made their ecclesiastics salaried officers of the Russian state. This ferment of unrest, which was provoked in the years 1903-04, was exacerbated by the renewed outbreak of the century-long racial feud between the Tatars and the Armenians, at Baku and other places. Nearly the whole of the region between the Caucasus and the Perso-Turkish frontier on the south, from the Caspian sea on the one side to the Black sea on the other, was embroiled in a civil war of the most sanguinary and ruthless character, the inveterate racial animosities of the combatants being in both cases inflamed by religious fanaticism. An end was put to these disorders only by the mutual agreement of the two contestants in Sept. 1905.

The Revolution of 1905 in Russia aroused the desire for self-government that has never long been dormant in the Caucasus. The agrarian policy of the Tsarist Government added fuel to the fire of discontent, and the refusal to recognize their individual national languages was a further source of grievance to Armenians, Tatars and Georgians alike. Nevertheless the Russian Govern-

ment ruthlessly pursued its repressive policy. On the outbreak of the World War in 1914, when they had learnt that Russia was the ally of France and Great Britain, the Caucasian nationalities eagerly responded to the call to arms. But even this action had no effect upon the Russian Government, and the governorship of General Yudenitch was specially noteworthy for its severity. Hence the February Revolution of 1917 was hailed with joy throughout the Caucasus when the individual nationalities attempted to establish a Federal republic that should be governed by a Transcaucasian diet. But the failure of Kerensky's administration and the triumph of Bolshevism spelt failure for the Caucasian Republic also. The component states made a brief attempt to preserve their independence of Moscow under mildly socialistic forms of government, but the military strength of the Soviet soon overcame their resistance. First one and then another was overrun and conquered, and Soviet republics set up under the guidance of Moscow. Despite the maintenance by the Moscow Government of these republics in the Caucasus, the desire amongst some of the population for complete independence of the U.S.S.R. has not been extinguished.

**CAUCASUS, CAMPAIGN IN THE.** Though both Russian and Turk spoke of a "Caucasus front" and gave to their armies engaged on this front the designation "Caucasian," in the World War, the operations actually took place at a considerable distance from the Caucasus.

**The Terrain Described.**—The main theatre of these operations may be defined as lying within the following limits; on the east, Batum (on the Black sea)-Kars-Mount Ararat; on the south, Lake Van-Mush-Kharput; on the west, Kemath-Erzinjan-Kiresün; and on the north, the south coast of the Black sea. The whole of this region is covered by the historical term Armenia—not merely the present republic of that name, but, in the wider sense of the term, the country which was inhabited in 1914 largely by the ill-starred Armenian nation. Outside this main theatre of operations, a somewhat desultory warfare was carried on by detachments from the main forces up and down the western parts of Persia. Though some of the valleys are fertile, the area as a whole is bleak, sparsely populated and almost undeveloped.

The poverty of the communications and the severity of the climate render military operations on a large scale difficult and arduous. In 1914, on the Russian side, railway communication ended at Sari Qamish, some 40m. southwest of Kars and 15 from the frontier; on the Turkish side, 600m. of indifferent roads and tracks separated their armies operating in the Erzerum area from the nearest railhead at Angora or Ulu Qishla, on the Baghdad railway northwest of Adana. Thus the advantage in land communications lay, at the outset, very decidedly with the Russians, who had also, except for a short period after the outbreak of War, command of the Black sea. On neither side, however, could the communication be considered in any way adequate for operations on the grand scale.

Few commanders would welcome a campaign in such extreme conditions of climate and difficulties of movement and supply. Neither army was up-to-date in its technical organization. The higher leading and staff work in both armies was rough and ready rather than scientific, though there were a number of German staff officers with the Turk and many highly educated and intelligent men in the Russian General Staff. Given the characteristics of the two armies and the restrictions to manoeuvre which the terrain imposed, it was sufficiently obvious that the campaigns were likely to be marked by hard, straightforward fighting rather than any striking display of military art. Only the hardiest of soldiers could have come to grips with each other at all in that waste of snow-clad hills, in the depths of winter when the campaign opened. It was at the end of October 1914, that Turkey definitely entered the World War on the side of the Central Powers, and opened hostilities by naval bombardment of Russian ports in the Black sea.

The strategy of the Central Powers would have naturally dictated as the most useful contribution of her new ally to the common effort a diversion likely to withdraw most Russian troops from the hard-pressed Austrians; and Liman von Sanders, the

chief of the German Military Mission in Turkey, is known to have proposed a scheme for the landing of a Turkish force at Odessa with this object. But this scheme, even apart from doubts whether command of the Black sea could be effectively secured, was, perhaps not unnaturally, viewed with disfavour by the Turks, who preferred the hope of reconquest of some of the territory, notably the fortress of Kars, lost to Russia in previous wars. The III. Turkish Army had been assembling during Sept. and Oct. in the neighbourhood of Erzerum. It consisted of the IX. and XI. Corps, the 2nd Cav. Div. and some mounted irregulars. During Nov. the X. Corps was added, bringing the fighting strength of the army up to approximately 100,000 men. All three corps were composed mainly of Anatolians, the best fighting material in Turkey.

**The Turkish Plan of Campaign.**—The plan evolved by Enver, whose megalomaniac mind seems to have dreamed of campaigns rivalling those of Alexander and extending even up to India, was a wide enveloping movement with Kars as the objective. The XI. Corps was to attack frontally toward the Russian railroad at Sari Qamish, while the IX. and X. Corps moved north from Erzerum, swept by difficult hill passes through Olti, on toward Kars and Sari Qamish. Still further north, a detachment which had landed at Trebizond was to advance on Ardahan. This grandiose plan wholly ignored the absence of communications and the climatic conditions. The Russian attitude was, at the outset, purely defensive; their main preoccupation was on their Western Front, which had absorbed nearly all the available forces; two of the three regular corps, stationed in the Caucasus in peace, had been sent on mobilization to defend the Western Front against Austria and Germany. Only two complete corps, the I. Caucasian and II. Turkestan, were at first available for the defence of the Caucasus. Yet the Russians made the first advance, moving a force across the frontier in Köpri Köi on the road to Erzerum. This advance was made to secure room for manoeuvre in front of the important base at Sari Qamish. The Turks promptly attacked, and some fierce fighting took place between Nov. 8 and 20, which ended in the withdrawal of the Turks.

Enver now arrived from Constantinople and assumed personal command of the III. Army. He insisted, against the views of his German advisers, on putting into execution the ambitious plan he had conceived. The routes by which the turning movement was made were mere mountain tracks deep in snow; the greater part of the artillery and transport had to be left behind, and the attempt seemed madness. Yet such fortitude and endurance did the poorly equipped and ill-fed Turkish troops display that they almost achieved the impossible. While the main Russian body was engaged with the XI. Corps, the IX. Corps appeared, in the last days of Dec., on the heights above Sari Qamish, and the X. Corps on its left approached the railway between Kars and Sari Qamish; the detachment from Trebizond had already driven the Russians out of Ardahan.

The Russian commander's nerve failed him at the crisis; and the situation was saved only by his chief of the staff, Gen. Yudenich, a man of considerable ability and imperturbable resolution. He collected forces for a counter attack, which resulted in the complete defeat and practical annihilation of the two Turkish turning corps, worn out and disorganized by their formidable approach march; the XI. Corps was then in its turn driven back. The total losses of the Turkish III. Army are said to have approximated to 85%. Enver at once handed over the command to Hawis Hakki Pasha and returned to Constantinople. Hawis Hakki died shortly after, and the command was given to Mahmoud Kiamil. The alarm caused in Russia by the Turkish incursion was such that an appeal was made to Great Britain for a diversion against the Turks. This led to the first suggestion for the Gallipoli expedition.

During the whole of 1915 the fighting on the Caucasus front was of minor importance only. The main preoccupation of the Russians lay on their Western Front, of the Turks in Gallipoli. The shattered III. Army was gradually reconstituted, and the Russians raised fresh units to increase their strength. But neither side was yet in shape for a serious offensive. The detachment of Turks which in the previous winter had advanced to Ardahan and

then had been driven back to Artvin, attempted in April a *coup de main* against Batum, but without success. On the other flank the Russians advanced their left wing into Armenia during May and June, occupied Van and threatened Bitlis. The Armenian rising which assisted the Russians led to bloody reprisals on their compatriots still in Turkish power. In Sept. 1915 the Grand Duke Nicholas took over command of the Caucasus front, an event which was to produce a marked enlargement of the Russian effort in this theatre. Grand Dukes in Imperial Russia could still obtain reinforcements in men and material denied to ordinary commanders. Nor did the character of the Grand Duke make it likely that he would adopt a passive rôle. Though not a great strategist, he was shrewd and energetic, as he had already shown while in command on the Western Front, a most loyal and unselfish supporter of the Allied cause. He found an able executive commander in Gen. Yudenich, already mentioned.

**The Taking of Erzerum.**—Once again an offensive on a large scale was made in the depth of winter. The Grand Duke wished to anticipate the arrival of Turkish reinforcements released by the British evacuation of Gallipoli. This enterprise was completely successful. The Russian capture of Erzerum was one of the finest feats of arms of the whole War. Its assault did not form part of the original plan, but the attacks up the Araxes valley, begun on Jan. 11, 1916, so completely surprised the Turk that it was decided to attempt it. The famous fortress, though many of the works and much of the armament were not modern, occupies a position of great natural strength, which the Turks under German supervision had improved with field works in addition to the existing forts. Its capture on Feb. 16 was mainly the result of a turning movement from the north, made by the II. Turkestan Corps under Przjevalski, the ablest of the Russian Corps commanders on the Caucasus front, who had an intimate knowledge of Erzerum, where he had spent 15 years as military attaché. The Turks retired in considerable disorder with heavy losses in men and material.

The next Russian objective was Trebizond; its capture in April considerably simplified the supply problem. Meanwhile, the Turkish Higher Command, alarmed at the fall of Erzerum and continued advance of the Russians, had decided on a counterstroke. They ordered the assembly of a new army, the II., under Izzet Pasha, in the Mush-Kharput region, to attack the Russian flank and rear and recapture Erzerum. The plan was sound enough, had the communications allowed of a speedy concentration and swift advance. But the assembly of the II. Army, begun in April, was not complete in July. The Grand Duke became aware of the Turkish intentions and anticipated their attack by a heavy blow at the III. Army, which eventually broke in complete rout. The Russians occupied Erzincan in July. So heavy were the losses of the III. Army that it had subsequently to be completely reorganized. To do this divisions were formed out of army corps, regiments out of divisions, battalions out of regiments.

The defeat of the III. Army delayed and weakened the counterstroke of the II. Army, which did not take place till August, giving the Russians time to transfer troops from their right wing to meet it. After some heavy fighting on the Oghnat-Kighi front the II. Army's effort was definitely held. It had gained little ground at a considerable sacrifice in men. Both armies then took up defensive positions for the winter. The line now ran approximately from Tireboli on the Black Sea, west of Gumushkane to Kemakh, then south-east by Kighi, Oghnat, Mush and Bitlis to Lake Van. Further east, on the Turko-Persian border and in Persia, both armies had detachments to protect their flank, and fighting took place with varying fortune during 1915-16.

During the winter of 1916-17 no movements took place. The Turkish II. and III. Armies (Mustapha Kemal and Wahib Pasha respectively), now combined under Izzet Pasha, suffered terrible privations from lack of supplies and the weather. Nor were the Russians very much better off. A light line was being built from Sari Qamish to Erzerum, but progress was very slow and railroad was still some miles short of Erzerum in March 1917. Their command of the sea enabled them to feed their right wing from Trebizond; but from Erzerum and Trebizond to the front,



supply was dependent on horse transport over indifferent tracks, sometimes closed for days by blizzards of snow. The Russians, too, suffered severely from poor rations and typhus.

**Attempted Russo-British Co-operation.**—In Dec. 1916 the British Army in Mesopotamia, under Gen Maude, commenced the attacks on the Turks at Kut, which were eventually to lead to the capture of Baghdad in March. Unsuccessful efforts had previously been made to concert the operations of the British in Mesopotamia and the Russians in the Caucasus; and now, with the approach of Maude's forces to Baghdad, an opportunity for effective combination seemed to have arrived. It was agreed that the Cavalry Corps of Baratov from Persia and of Chernozubov from between lakes Urmia and Van (both these corps, though composed mainly of cavalry, had a strong backing of infantry and artillery) should advance on Mosul; and thus, it was hoped, in co-operation with Maude, finally liquidate the Mesopotamian campaign. However, it was not to be. The Grand Duke adopted the plan whole-heartedly, and the Turk would not have been in a position to offer effective resistance. But, first of all, the weather conditions and the difficulty of organizing a line of supply through the mountains of the Persian border caused delay; then, before the movement had well begun, the Russian revolution broke out. With the recall of the Grand Duke toward the end of March—only to be described as an incredible blunder on the part of Keren-ski—the best hope of energetic action had gone.

**Collapse of the Russian Army.**—Throughout the summer the Russian Army lay inactive, gradually disintegrating; by the early autumn it was sufficiently obvious that the troops would make no further forward movement, and could only be relied on to hold their positions so long as they were not attacked. Yudenich, who had succeeded the Grand Duke, gave up the command in August and was succeeded by Przhevalski. But the end was near. In December an armistice was concluded on the Caucasus front, and in Jan. 1918, after the peace of Brest-Litovsk, the Russian troops still remaining retired. The condition of the Turkish armies had been too wretched to allow them up till now to take advantage of the Russian collapse; but when the Russians finally retired, the Turks were once more fired with hopes of territorial gains; and advanced on the Caucasus with troops which from the military point of view would have been more profitably employed in strengthening their front in Palestine. They occupied Batum on April 14 and Kars on the 26th. All Russian regular troops had disappeared, and their only opponents were Georgian and Armenian bands defending their homes.

**The British Expedition to Baku.**—The British General Staff, alarmed at the prospect of a Caucasus under Turkish control being used as a base of propaganda and even operations against India, had meanwhile organized a group of British officers and non-commissioned officers under Gen. Dunsterville to be sent to the Caucasus to rally the local Armenian and Georgian populations against the Turk. But this force, dispatched through Persia from Mesopotamia, was delayed by the anarchic conditions which followed the collapse of the Russian forces in Persia, and arrived too late. When it reached Baku in August, things had gone too far; and after a short but gallant defence it was compelled to withdraw. But the Turkish control of Trans-Caucasia was short-lived, for Allenby's crushing victory in Palestine a month later settled the loss of the war for the Turks.

**Criticisms of the Campaign.**—The operations of the so-called "Caucasus Front" described above thus led to no decisive results on either side. In view of the poor means of communication in the theatre of operations it is difficult to see how decisive results could have been expected. The lure of territorial conquest and false strategical conceptions led the Turks to attach an undue importance to this front, which had disastrous consequences for them from a military point of view. The unnecessarily heavy losses in their best troops caused by the offensives of the III. Army at the end of 1914 and of the II. Army in 1916 caused the weakness which proved their undoing on the Palestine and Mesopotamian fronts. Had the Turks been content with a defensive attitude on the Caucasus Front, British difficulties in these theatres might have been greatly increased.

The purely defensive attitude which the Russians took up at the outset was strategically correct; they had no other objective than the protection of their Transcaucasian provinces from invasion; the state of the communications would obviously never allow them to penetrate far enough into Asia Minor to produce any decisive effect on Turkey. That they advanced as far as they did—farther, perhaps, than was strategically wise—was due to the influence and energy of the Grand Duke. From the military point of view these campaigns are likely to be remembered only for one great feat of arms—the boldness and endurance displayed in the capture of Erzerum—and as affording to soldiers one more example of the dependence of strategy on communications.

(A. P. W.)

**CAUCHON, PIERRE**, French ecclesiastic, was born near Reims and became bishop of Beauvais in 1420. About ten years later he joined the English faction in France, and his chief title to fame is that he presided over the trial of Joan of Arc at Rouen. Recent researches show that he did so in a spirit of great justice and impartiality, and it must be remembered that he did not condemn the Maid to death but only to imprisonment for life. The death sentence was passed by the civil court. In 1432 he became bishop of Lisieux, and took part in the Council at Basle in 1435. He died in 1442, and was subsequently excommunicated by Calixtus IV.

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**CAUCHY, AUGUSTIN LOUIS**, BARON (1789-1857), French mathematician, was born in Paris, on Aug. 21, 1789, and died at Sceaux (Seine) on May 23, 1857. He studied at the École Polytechnique and the École des Ponts et Chaussées, and practised for some time as an engineer. His health failed in 1813, and his father's friends, Lagrange and Laplace, persuaded him to devote himself entirely to mathematics. From 1816 onwards he held three professorships in Paris, which he lost at the revolution of 1830, on declining to swear allegiance to Louis Philippe. A chair of mathematical physics was created for him at the University of Turin. He spent some time travelling with the duke of Bordeaux, grandson of Charles X, and in 1838 returned to France, resuming his chair at the École Polytechnique. Although acting only from the highest motives, Cauchy made himself objectionable to his colleagues by a self-righteous obstinacy and an aggressive religious bigotry.

The genius of Cauchy was promised in his simple solution of the problem of Apollonius; i.e., to describe a circle touching three given circles, which he discovered in 1805, and in his generalization of Euler's theorem on polyhedra in 1811, etc. More important is his memoir on wave propagation which obtained the *grand prix* of the Institut in 1816. His greatest contributions to mathematical science are characterized by the clear and rigorous methods which he introduced and are mainly embodied in his three great treatises, *Cours d'analyse de l'École Polytechnique* (1821); *Le Calcul infinitésimal* (1823); *Leçons sur les applications du calcul infinitésimal à la géométrie* (1826-28). He clarified the principles of the calculus by developing them with the aid of limits and continuity, and was the first to prove Taylor's theorem rigorously, establishing his well-known form of the remainder. Thus the first phase of modern rigour, giving a satisfactory basis for the calculus, originated in Cauchy's lectures and researches of the 1820s in analysis. To the same period belongs his development of his (the first) version of the theory of functions of a complex variable, today indispensable in applied mathematics from physics to aeronautics. With equal originality, he made substantial contributions to the theory of numbers where, however, he went astray on Fermat's last theorem. He was one of the originators of the theory of permutation groups. In astronomy, he gave a shorter account than Leverrier's of the motion of Pallas. In mechanics, he made many researches, substituting the notion of the continuity of geometrical displacements for the principle of the continuity of matter. In optics, he developed the wave theory, and his name is associated with the simple dispersion formula. In elasticity, he

originated the theory of stress, and his results are nearly as valuable as those of S. D. Poisson. His collected works, *Œuvres complètes d'Augustin Cauchy*, have been published in 27 volumes.

See C. A. Valson, *Le Baron Augustin Cauchy: sa vie et ses travaux* (1868).

**CAUCUS**, a political term used in the U.S.A. of a special form of party meeting, and in Great Britain of a system of party organization. The word originated in Boston (Mass.), in the early part of the 18th century, when it was used as the name of a political club, the "Caucus" or "Caucas" club. Here public matters were discussed, and arrangements made for local elections and the choosing of candidates for offices. A contemporary reference to the club occurs in the diary of John Adams in 1763; but William Gordon (*History of the Independence of the United States of America*, 1788) speaks of the Caucus as having been in existence some fifty years before the time of writing (1774) and describes the methods used for securing the election of the candidates. The derivation of the word has been much disputed. The most plausible origin is an Algonquin word, *kaw-kaw-was*, meaning to talk, Indian words and names having been popular in America as titles for societies and clubs; cf. "Tammany." In the United States "caucus" is used strictly of a meeting either of party managers or of duty voters, as for instance, a "nominating caucus," for nominating candidates for office or for selecting delegates for a nominating convention. The caucus of the party in congress nominated the candidates for the offices of president and vice-president from 1800 till 1824, when the convention system was adopted. At the same time, the candidates for governor and lieutenant governor were nominated by the party members of the state legislatures in what was known as the "legislative nominating caucus." Occasionally districts unrepresented in the legislature sent delegates to sit in with the members of the legislature when these nominations were made and this was termed the "mixed legislative nominating caucus." (See PRIMARIES.)

The word is used in the United States to denote meetings of the members of a party in Congress or in a legislature or a city council, to determine matters of party policy on proposed legislation or legislative offices. "Caucus" first came into use in Great Britain in 1878 in connection with the organization of the Liberal Association of Birmingham by Joseph Chamberlain and F. Schnadhorst on strict disciplinary lines, more particularly with a view to election management and the control of voters, which became the model for other Liberal associations throughout the country. It was to this supposed imitation of the U.S. political "machine" that Lord Beaconsfield gave the name "caucus," and the name came to be used, not in the U.S. sense of a meeting, but of a closely disciplined system of party organization, chiefly as a stock term of abuse applied by politicians of one party to the controlling organization of its opponents.

**CAUDINE FORKS**, the *furculae Caudinae* (Casale di Forchia?), narrow passes in the mountains near Caudium in Samnium, and the scene of a famous Roman defeat in the Samnite wars. (See *ROME: Ancient History*.)

**CAUL**, a close-fitting woman's cap, especially one made of network worn in the 16th and 17th centuries; hence the membranous covering to the heart, brain, or the intestines, and particularly, a portion of the *amnion*, which is sometimes found remaining round the head of a child after birth. To this, called in Scotland "sely how," holy or lucky hood, many superstitions have been attached; it was looked on as a sign of good luck, and when preserved, was kept as a protection against drowning.

**CAULAINCOURT, ARMAND AUGUSTIN LOUIS, MARQUIS DE** (1772–1827), French general and diplomatist, was born at Caulaincourt on Dec. 9, 1772, of a noble family. He early entered the army, did not emigrate in the revolution, but was deprived of his grade as captain in 1793, and served in the ranks. In 1795, through the protection of L. Hoche, he became captain again, was colonel in the Army of the Rhine in 1799–1800, and after the peace of Lunéville (1801) was sent to St. Petersburg (Leningrad) to negotiate an understanding between Russia and France. On his return he was named aide-de-camp of the First Consul. He was employed to seize some agents of the English government in

Baden in 1804, which led to the unfounded accusation that he was concerned in the arrest of the duc d'Enghien. He received the title of duke of Vicenza (1808). Napoleon sent him in 1807 as ambassador to St. Petersburg (Leningrad), where Caulaincourt tried to maintain the alliance of Tilsit, and succeeded in maintaining the peace for some years. He accompanied Napoleon during the invasion of Russia, from which he had in vain sought to dissuade him. During the last years of the empire, Caulaincourt was charged with all the diplomatic negotiations. He signed the armistice of Pleswitz, June 1813, represented France at the congress of Prague in Aug. 1813, at the congress of Chatillon in Feb. 1814, and concluded the treaty of Fontainebleau on April 10, 1814.

When Napoleon returned from Elba, he became minister of foreign affairs. After the second Restoration, Caulaincourt's name was on the proscription list, but it was erased on the personal intervention of Alexander I with Louis XVIII.

Caulaincourt's memoirs appeared under the title of *Souvenirs du duc de Vicence* in 1837–40.

**CAULICULUS**, in architecture, a form like a stalk, crowned with leaves, but which grow scrolls, leaves or other stalks; especially in the Corinthian capital, and in the branching scroll or *rinseau*.

**CAULIFLOWER**: see CABBAGE.

**CAULONIA**, a town of the district of the Bruttii, Italy, on the east coast, on the promontory Capo Stilo, near Monasterace (Gr. *Καυλωνία*). It was the southernmost Achaean colony founded as an outpost of Croton or direct from Greece itself. In the 7th century it was allied with Croton and Sybaris, and coins, going back to 550 B.C., prove its importance. It took the side of Athens in the Peloponnesian War. In 389 B.C. it was destroyed by Dionysius, but soon afterwards restored. It was captured during the invasion of Pyrrhus by Campanian troops. Strabo speaks of it as deserted in his time. Excavations have revealed remains of the fortifications, with towers of the 7th–6th century B.C. A small temple must have stood near the lighthouse, and to it belonged architectural terra-cottas, and votive objects in the same material, especially small altars. The houses that have been found belong to a later period. Near the shore scanty remains of a large Doric temple (first half of 5th century B.C.) were found: also a trench full of architectural terra-cottas of this period. The tombs date from the 7th–3rd century B.C. but are poor.

See P. Orsi in *Monumenti dei Lincei*, xxiii. (1914) 685 seq.; xxix. (1924) 409 seq.

**CAUSALITY** or **CAUSATION** signifies the relation of cause and effect. Common sense assumes that things and events are the products or results of certain other things or events—the result is called the effect, and that which produces it is called the cause. The attempt to understand things usually takes the form of trying to discover their causes and effects. The belief in causes and effects is most probably derived partly from the human experience of exercising various activities in order to produce certain results or to achieve certain ends, and partly from the experience of suffering the effects of the actions of others. In the early stages of human thought natural phenomena were (and in the case of the young or the undeveloped still are) conceived after the analogy of such human experiences of doing things and of being acted on, of causing effects or suffering them. The mythological accounts of natural phenomena abundantly illustrate the anthropomorphic tendencies in the early attempts to explain or to understand reality. With the growth of rational knowledge the anthropomorphic elements in the interpretation of natural phenomena have gradually been eliminated, and a certain amount of suspicion has fallen upon the concept of causality. Some scientists, indeed, have gone so far as to reject it altogether from the realm of science. How this has come about will be explained presently. But it may be stated at once that this extreme attitude seems to be unwarranted, even if we admit the importance of checking one's conception of the causal relationship so as to purge it of anthropomorphic suggestions when applied to inanimate natural phenomena. Except among believers in magic, at the one extreme, and among thorough-going sceptics, at the other extreme, it is usually assumed,

either explicitly or at least implicitly, that every event has a cause, and that the same kind of cause has the same kind of effect. This assumption is commonly known as *the Postulate or Principle of Universal Causation*.

**The Rationale of the Concept of Causality.**—Let the attempt be made to dispense with the idea of causal connection. The resulting view of the world would be one of a mere sequence of disconnected phenomena. Now, some people are quite content to regard the world in that way—to view the ever-changing phenomena of nature as a mere sequence of new happenings in which each successive stage is in no sense the outcome of the preceding stage, but a new creation so to say. In a sense this was a favourite thought of certain scholastics, and even Descartes shared this view. Most people, however, find such a world of disconnected changes, or rather displacements, theoretically unintelligible and practically bewildering. Even the supporters of the aforementioned view of incessant new creations could not entirely abandon the conception of causality. For they regarded God as the Creator (or Cause) of each successive creation in the sequence of mutually disconnected events. But the thought of such supernatural interference at every moment in the flow of events is not likely to appeal to many men of science. Even on religious grounds some people would object to the conception of a world, or rather of innumerable worlds, so ill-constructed by the Maker as to have to be scrapped and replaced every moment. It seems to be more satisfying to human intelligence, and more in accordance with human experience, to suppose an orderly continuity in each sequence of changes. And the causal concept gives expression to this implicit faith in the connected continuity of events. The scientific conception of the conservation of matter or energy is prompted very largely by the same kind of consideration, namely, the belief that there are no phenomena arising suddenly out of nothing as it were, but that in some sense each event is the outcome of preceding events, that each event is in fact only a new manifestation of the matter or energy of some preceding event or events. The rationale or logical motive of the concept of causality is, in short, to be found in the effort to see orderly continuity in the world of reality. And the sense of, or feeling for, continuity may itself be derived psychologically from man's consciousness of his own continuity under normal conditions.

**The Inferential Character of Causal Connections.**—The causal relation between events is not something that can be perceived by means of the senses. What we perceive is *sequence* of events; and it is from their sequence that we feel justified in inferring their causal connection, provided certain conditions are satisfied (for these conditions see the article SCIENTIFIC METHOD). The inferential character of our beliefs in causal connections exposes them to adverse criticisms of an easy kind. It may be argued, indeed it has been argued, that the inference to causal connection may be wrong, or that it is highly speculative, so why not confine ourselves to the description of the bare sequence and ignore the question of causation? Such, for instance, was the view of David Hume (*q.v.*), who contended that the alleged causal necessity in the sequence of the so-called causes and effects is just the hypostasis or projection of our habit of expecting certain consequents to follow certain antecedents merely because we had observed those sequences on previous occasions. It was largely in consequence of Hume's criticism that Kant concluded that causality is a category, that is, one of the ultimate *a priori* forms in which the understanding spontaneously orders its experiences (see CATEGORY)—something that is not derived from experience, but on the contrary is required to make orderly experience itself possible. It is noteworthy that Hume's attempt to explain away causality made use of this very category. For if there were no causal connection between the repeated observation of a certain sequence and the formation of a corresponding habit of expectation, Hume's adverse criticism of causality would have no basis in fact. Moreover, if Hume were taken literally we should have no ground for supposing any connection between his thoughts and his utterances, and so could not surmise what he really thought about causality or anything else. Common sense revolts against the attempt to reduce causality to bare sequence. The attempts offend

the active nature of man. Moreover, not every sequence is a causal sequence. Many beliefs that common sense condemns as superstitious are beliefs that result from an inability to distinguish between mere sequence and connection, so that if one event follows another (say, illness or death after being one of a party of thirteen) it is regarded as its effect. At the stage of logical reflection this slovenly way of thinking is condemned as the fallacy *post hoc, ergo propter hoc* (after this, therefore because of it).

**Cause and Law.**—Prompted partly by Hume's criticism, partly by Kant's apparently subjective interpretation of causality, and partly by the anthropomorphic origin of the conception of causation, some modern thinkers (Helmholtz, Mach, Pearson and others) have urged that science should discard it in favour of the concept of law. This movement is intimately connected with the tendency to make science purely descriptive without any pretence to be explanatory. The causal concept, it is urged, is an explanatory concept with a tincture of fetishism about it, why not confine the business of science to the discovery of descriptive laws expressing uniform sequences, without pretending to explain these by reference to alleged causes? This trend of thought fits in very well with the main tendency of the more exact sciences in modern times. Under the influence of Copernicus, Galilei, Descartes and Newton the aim of the physical sciences has come to be regarded as that of discovering descriptive equations expressing quantitative correlations of phenomena. Correlated phenomena are treated like mathematical functions. Causal connections tend to be ignored, in fact everything tends to be ignored that cannot be expressed in equations. This movement is really a legacy from ancient Pythagoreanism, which identified the essence of things with numbers. That philosophy has indeed been abandoned long since, but its consequences have been retained. And this notwithstanding the growing realization that mathematical equations, after all, tell us extremely little about the real nature of things, apart from their comparatively external quantitative correlations. So marked is this tendency to let equations supplant causal connections that it has actually been urged that there is no good reason for the customary restriction of the term cause to antecedents only, and of the term effect to consequents only, seeing that antecedents and consequents are mutually inferable. This is to save the name and kill the meaning of cause—causality is not the same as law or uniformity. It may be found in unique events (such as the biographer and the historian are mostly concerned with) that are not formulated in laws at all. On the other hand, there are laws, even laws of sequence, that are either not causal at all (say, the sequence of a mathematical progression) or at least are not directly causal (say, the sequence of day and night, or of the seasons). Even when expressible in laws or uniformities of sequence, the causal connection is something more than the bare uniformity of sequence. No doubt it is objectionable to introduce anthropomorphism or animism into the study of inanimate phenomena. No doubt it is well to remember the obstruction to science caused by "substantial forms," etc. But caution may be carried too far. After all, even human beings are natural phenomena, and their experiences may be used as a clue to the interpretation of nature, provided due care is exercised. It would certainly be extravagant to project into the causal sequences of inanimate phenomena anything analogous to the sense of effort or of constraint that is experienced in human activity or passivity respectively. But that is no reason for discarding causality altogether. Carried through consistently, this can only end in the conception of the world as a series of independent miracles—a view even more irrational than the anthropomorphism which it is intended to correct. The principle of conservation of matter or energy would lose all significance without the idea of causal continuity, according to which certain successive events not only *follow*, but *follow from* one another. In fact, mere laws of sequence are only intelligible in the last resort, when they can be shown to result from direct or indirect causal connections.

**Cause and Condition.**—To explain adequately the term cause, it is necessary to show its relation to the term condition. A condition is anything that is necessary to a certain result—anything in the absence of which that result would not be achieved. A thing



may, however, be indispensable to a certain result and yet be insufficient to produce it. For instance, a damp atmosphere is necessary for fine cotton-spinning; but other things are required besides—cotton, machines, workers, etc. Now the cause of a certain effect is that totality of conditions that is sufficient to produce it. As a rule a cause is complex—it consists of a number of conditions each of which is only a part of the cause. Popularly some one condition is selected and called the cause. This is frequently legitimate, inasmuch as the presence of the other conditions is obviously assumed, and it would be pedantry to name them all. But at other times it is due to oversight—many rival remedies for social ills are each but a condition rather than a likely cause of the effect aimed at. Another fact to be noted is that the expected result does not always follow when all the necessary conditions appear to be operative. This happens when there are counteracting forces at work that thwart the expected result. For example, the sunshine that would normally flood a room with light and warmth may be excluded by closed shutters. To secure a certain effect it is therefore necessary to secure the absence of counteracting conditions as well as the presence of all the *positive* or contributory conditions. The absence of all hindrances to an effect is usually described as its *negative* condition. So that the complete cause will consist of negative as well as positive conditions. Negative conditions may play a very important rôle, as when armies or taxpayers suffer through insufficient vigilance.

A word may be added about *Plurality of Causes*, or the view that the same kind of effect may in different instances be produced by different kinds of causes. In a general way different causes may produce results that may serve the same practical purpose—light, warmth, satisfaction, death, etc., may be produced in a large variety of ways, and yet make no serious practical difference. Strictly speaking, however, the effect is always different in some way when the cause is different in any way. Although death, e.g., may result from any of the thousand ills that flesh is heir to, and it may make little or no practical difference which of them actually caused it, yet when the occasion requires it coroners' inquests are held in the just belief that differences in the cause of death can be inferred from differences in the state of the dead body. So that, strictly speaking, not only does the same cause always produce the same effect, but the same effect can only be produced by one kind of cause.

**HISTORICAL.**—The category of causality must have been used implicitly from the very dawn of human intelligence. But the implicit use of a category is one thing, its explicit formulation is another thing. The oldest formulation on record is that of Leucippus (5th century B.C.), who formulated the principle that "nothing happens without a cause, everything has a cause and is necessary." Plato distinguished various kinds of causes. But the distinctions best known and most widely accepted during many centuries are those made by Aristotle, who recognized *material*, *formal*, *efficient* and *final causes*. He maintained that in order to understand some things completely we must know (1) the *material* of which they are made, (2) the *form* or law of their structure, (3) the active agent or *agency* that effected the imposition of the form upon the matter, and (4) the *final purpose* or end that the effect is adapted to serve. These four types of causes were elaborated during the middle ages, and the text-books on Logic that were in vogue in the 17th century (e.g., Burgersdijck's or Heereboord's *Logic*) distinguish some 40 kinds of causes (a summary of these will be found in A. Wolf, *Spinoza's Short Treatise*, pp. 190–195). These distinctions were not as extravagant as may be supposed. Interpreted as kinds of *conditions*, rather than causes, many of them are still worthy of consideration, and some of them are actually still in use in law and medicine. The less known distinctions that are of importance in the history of philosophy are those of *immanent* and *occasional causes*. An immanent cause is one the effects of which remain within it, as distinguished from a *transitive cause*, which operates on things outside itself. For instance, God, according to Spinoza, is an immanent cause, for, according to pantheistic philosophy, there is nothing outside God; on the other hand, the popular conception of God is mostly

that of a transitive Cause, creating and maintaining a world outside Himself. An *occasional cause* is simply the occasion of an occurrence, whereas an efficient cause is what produces it. According to Occasionalism (*q.v.*), bodily changes do not produce mental ones, or vice versa, but a change of either kind is the occasion for the occurrence of a change of the other kind, through the intervention of God as efficient cause.

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**CAUSE AND EFFECT:** see CAUSALITY.

**CAUSEWAY.** A path on a raised dam or mound across marshes or low-lying ground; the word is also used of old paved highways, such as the Roman military roads. "Causeway" is still used dialectically in England for a paved or cobbled footpath. The word is properly "causey-way," from *causey*, a mound or dam which is derived, through the Norman-French *caucie* (*cf.* modern *chaussée*), from the late Latin *via calciata*, a road stamped firm with the feet (*calcare*, to tread).

**CAUSSES,** a natural region in the south of the central plateau of France, chiefly in the departments of Lozère and Aveyron, west of the curving Cevennes and south of the Lot valley. This vast plateau of Jurassic limestone, sloping westwards, is divided into several sections by deep-cut river channels. These smaller plateaux, barren and deserted, are called the *Causse*s from *cau*, the local form of the French *chaux*, i.e., lime. The most typical is the Causse Méjan, south of the Tarn between Florac and Millau, a sterile sparsely-peopled table-land lying between 3,000 and 4,000 ft. above sea-level. To the north lies the Causse de Sauveterre prolonged westwards by the Causse de Sévérac. Those of Quercy, Gramat and Rouergue are lower and less arid. Drainage features such as underground streams, fissures and pot-holes (*avens*) are characteristic. The inhabitants (*Causse*nards) cultivate rye and potatoes where possible, but subsist for the most part on the sheep from whose milk Roquefort cheese is made. Similar dry limestone areas elsewhere are designated under the cognate German *Karst* or Italian *Carso* (*q.v.*).

**CAUSSIN DE PERCEVAL, ARMAND-PIERRE** (1795–1871), French Orientalist, was born in Paris, where he died during the siege.

His father, Jean Jacques (1759–1835), was professor of Arabic at the Collège de France, and his son, after extended travels in Asia Minor, succeeded to his chair.

His works include a useful *Grammaire arabe vulgaire* (4th ed., 1858), and an enlarged edition of Elie Bocthor's *Dictionnaire français-arabe* (3rd ed., 1864); but his great reputation rests on his *Essai sur l'histoire des Arabes avant l'Islamisme, pendant l'époque de Mahomet* (3 vols., 1847–49), in which the native traditions as to the early history of the Arabs, down to the death of Mohammed and the complete subjection of all the tribes to Islam, are set forth with much learning and lucidity.

**CAUSTIC.** That which burns (Gr. *καυστικός*, burning). In *surgery*, the term given to substances which destroy living tissues and so inhibit the action of organic poisons, as in bites, malignant disease and gangrenous processes. Such caustic substances include silver nitrate (Lunar caustic), Potassium and Sodium Hydrates (the Caustic Alkalis) (see *ALKALI*), Zinc chloride, an acid solution of mercuric nitrate, and pure carbolic acid (Phenol).

In *mathematics*, the "Caustic Surfaces" of a given surface are the envelopes of the normals to the surface, or the loci of its centres of curvature.

In *optics* (geometrical optics) the term "Caustic" is applied to the envelope of luminous rays after reflection or refraction. In the first case the envelope is termed a cata-caustic, in the second a dia-caustic. Cata-caustics are to be observed as bright curves when light is allowed to fall on a polished cylindrical surface as a napkin ring or a curved polished riband of steel placed on a table. By varying the curvature of the riband of steel or moving the source of light a variety of patterns can be obtained. The investigation of caustics, based as it is on the assumption of the law of the rectilinear propagation of light and the validity

of the experimental laws of reflection and refraction, is essentially of a geometrical nature, and as such attracted the attention of mathematicians of the 17th and succeeding centuries, more notably John Bernoulli, G. F. de l'Hopital, E. W. Tschirnhausen and Louis Carre.

See Arthur Cayley's *Memoirs on Caustics* in Phil. Trans. for 1857 and 1867.

**CAUSTIC SODA** (sodium hydroxide, NaOH) is a solid, white, deliquescent chemical compound much used as an intermediate material in the production of many chemicals. It is generally made by one of two methods, either through exchange of base by the causticizing of soda-ash ( $\text{Na}_2\text{CO}_3$ ) with hydrated lime or directly, through the action of an electric current upon a solution of common salt (NaCl). The latter newer process is tending to supersede the former, especially where cheap electric power is available or where a ready market for chlorine and hydrogen, by-products of the electrolytic process, exists. Because of its large production, caustic soda is classed as a "heavy chemical." It is used as an alkaline reagent, in the manufacture of soap, sodium salts, rayon, paper, medicines, textile products, in petroleum and vegetable oil refining, in tanning and in the synthesis of many organic compounds such as indigo, alizarin, resorcin, formates and oxalates.

**CAUTERETS**, a watering-place of southwestern France in the department of Hautes-Pyrénées, 20 mi. S. by W. of Lourdes by rail. Pop. (1946) 1,012. It lies in the beautiful valley of the Gave de Cauterets, and is well known for its thermal springs, and as a station for winter sports. Some 50,000 visitors are attracted annually. The 22 springs produce copious supplies of sulphuretted water and serve nine *établissements*. Their temperature varies between 75° and 137°. Cauterets is a centre for excursions, the Monné (8,937 ft.), the Cabaliros (7,651 ft.), the Pic de Chabarrou (9,550 ft.), the Vignemale (10,820 ft.), and other summits being in its neighbourhood. The properties of the waters have been known at least since the 10th century: they became famous in the 16th century when Marguerite de Valois composed the "Heptameron," on the model of Boccaccio's "Decameron," while visiting the spa with her court.

**CAUTIN**, a province of southern Chile, bounded north by Malleco and Arauco, east by Argentina, south by Valdivia, and west by the Pacific. Area 6,707 sq.mi.; pop. (1951 est.) 311,315, including many European immigrants, principally Germans. Cautin lies within the temperate rain forest region of the south, its chief products being timber, cattle, grain and apples. The State railway from Santiago to Puerto Montt crosses the province from north to south; branch lines to such places as Cherquenco, Cunco, Tolten and Carahue provide good rail service to most parts of the province. Two partially navigable rivers cross the province from east to west: the Tolten and the Cautin, the lower reaches of the latter being known as the Río Imperial. The province once formed part of the territory occupied by the Araucanian Indians, and Temuco, the capital of the province, long remained the centre of greatest concentration of these people. Temuco, a city of 42,035 inhabitants in 1944, is on the Río Cautin. It is an important rail centre, market town, and gateway to the famous lake district of south Chile.

**CAUTLEY, SIR PROBY THOMAS** (1802-1871), English engineer and palaeontologist, was born in Suffolk in 1802. After some years' service in the Bengal artillery, which he joined in 1819, he was engaged on the reconstruction of the Doab canal. He had charge of the completed canal for 12 years (1831-43). In 1840 he reported on the proposed Ganges canal, for the irrigation of the country between the rivers Ganges, Hindan, and Jumna. This project was sanctioned in 1841, but the work was not begun till 1843, and even then Cautley found himself hampered in its execution by the opposition of Lord Ellenborough. For want of competent help he had to do the drudgery of surveying and levelling himself, for some time. From 1845 to 1848 he was absent in England owing to ill-health, and on his return to India he was appointed director of canals in the North-western Provinces. After the Ganges canal was opened in 1854 he spent some time in England, and from 1858 to 1868 he occupied a seat

on the council of India. He died at Sydenham, near London, on Jan. 25, 1871. Cautley was a distinguished palaeontologist and contributed numerous memoirs, some written in collaboration with Dr. Hugh Falconer, to the *Proceedings* of the Bengal Asiatic Society and the Geological Society of London on the geology and fossil remains of the Sivalik hills.

**CAUVERY**, a river of southern India. Rising in Coorg, high up amid the Western Ghats, in 12° 25' N. lat. and 75° 34' E. long., it flows generally south-east across the plateau of Mysore, and finally enters the bay of Bengal through two principal mouths in Tanjore district. Its length is 472 m. Its course in Coorg is tortuous, and its bed generally rocky with high banks covered with luxuriant vegetation. On entering Mysore it passes through a narrow gorge, but presently widens to a breadth of 300 to 400 yd. The bed is too rocky for navigation. In its course through Mysore the channel is interrupted by a number of anicuts or dams for irrigation. In Mysore state the Cauvery forms the two islands of Seringapatam and Sivasamudram, which vie in sanctity with the island of Seringam lower down in Trichinopoly district. Around the island of Sivasamudram are the celebrated falls of the Cauvery, where the river branches into two channels, each of which makes a descent of about 320 ft. After entering the Madras presidency, the Cauvery forms the boundary between the Coimbatore and Salem districts, until it reaches Trichinopoly district. Sweeping past the historic rock of Trichinopoly, it breaks at the island of Seringam into two channels, which enclose between them the delta of Tanjore, the garden of southern India. The northern channel is called the Coleroon (Kolidam). On the seaward face of its delta are the open roadsteads of Negapatam and French Karikal. The only navigation on any portion of its course is carried on in boats of basket-work. There is an extensive irrigation system in the delta. The most ancient work is a massive dam of unhewn stone, across the stream of the Cauvery proper, which is supposed to date back to the 4th century, but is still in excellent repair. The chief modern work is the anicut across the Coleroon, 2,250 ft. long, which irrigates an area of some 600,000 acres. Altogether a total of about a million acres are irrigated from the Cauvery, and the Cauvery falls have been utilized for an electric power plant, which supplies power to the Kolar goldmines and light and power to Bangalore and Mysore.

The Cauvery is known to devout Hindus as Dakshini Ganga, or the Ganges of the south, and the whole of its course is holy ground. The Cauvery reservoir project, which will largely improve and extend the irrigation facilities, was sanctioned in 1925. It will include a dam at Metur and a canal 88 m. long.

**CAVA DEI TIRRENI**, a town and episcopal see of Campania, Italy, in the province of Salerno, 6 mi. N.W. by rail from the town of Salerno. Pop. (1936), town, 12,214; commune, 33,051. It lies fairly high in a richly cultivated valley, surrounded by wooded hills, and is a favourite resort. A mile to the southwest is the village of Corpo di Cava (1,970 ft.), with the Benedictine abbey of La Trinità della Cava, founded in 1025 by St. Alferius. The church and the greater part of the buildings were entirely modernized in 1796. The old Gothic cloisters are preserved. The archives, now national property, include documents and MSS. of great value.

M. Morcaldi, *Codex Diplomaticus Cavensis* (1873-1893) has published many important documents relating to the abbey.

**CAVAEDIUM**, in architecture, a synonym for atrium (*q.v.*), the central hall or court of a Roman house. Vitruvius lists five types: 1. The Tuscanicum. This, the most common type, was without columns, the hole in the roof being supported by the framing of the roof timbers. 2. The Tetrastylon, in which four columns supported the roof at the corners of its opening. 3. The Corinthian, in which more than four columns are employed, so that the cavaedium becomes, in essence, a peristyle (*q.v.*). 4. The Displuviatum, where the roof sloped down, away from the opening, instead of towards it. 5. The Testudinatum, in which the entire area was covered by a continuous roof.

**CAVAGNARI, SIR PIERRE LOUIS NAPOLEON** (1841-1879), British military administrator, the son of a French general by his marriage with an Irish lady, was born at Stenay,

Meuse, on July 4, 1841. He obtained naturalization as an Englishman, and entered the military service of the East India Company. He served through the Oudh campaign against the mutineers in 1858 and 1859. In 1861 he was appointed an assistant commissioner in the Punjab, and in 1877 became deputy commissioner of Peshawar and took part in several expeditions against the hill tribes. In 1878 he was attached to the staff of the British mission to Kabul, which the Afghans refused to allow to proceed. In May 1879, after the death of the amir Shere Ali, Cavagnari negotiated and signed the treaty of Gandamak with his successor, Yakub Khan. By this the Afghans agreed to admit a British resident at Kabul, and Cavagnari was appointed. He took up his residence in July, and for a time all seemed to go well, but on Sept. 3 Cavagnari and the other European members of the mission were massacred in a sudden rising of mutinous Afghan troops. (See *AFGHANISTAN*.)

**CAVAIGNAC, LOUIS EUGÈNE** (1802-1857), French general, born in Paris on Oct. 15, 1802, belonged to a family famous in French revolutionary annals. He was the son of JEAN-BAPTISTE CAVAIGNAC (1762-1829), who was a member of the Convention, and acted as its commissioner in the repression of the opponents of the Revolution in various parts of France. At the Restoration he was proscribed as a regicide. Jean-Baptiste's brother, JACQUES MARIE, VICOMTE CAVAIGNAC (1773-1855), was one of Napoleon's generals and commanded the cavalry of the 11th Corps in the retreat from Moscow (1812). GODEFROY CAVAIGNAC (1801-1845), elder brother of Louis Eugène, took part in the Parisian risings of Oct. 1830, 1832 and 1834, and was one of the founders of the Société des Droits de l'Homme. Very highly esteemed for his chivalrous character among the republicans, he was probably personally both the most estimable and able of the old guard of republicans. His reputation was largely, if not wholly, responsible later for the advancement of Louis Eugène, who entered the army.

In 1831 Louis Eugène was removed from active duty in consequence of his declared republicanism, but in 1832 he was recalled to the service and sent to Algeria, where he held a series of commands during the next 16 years. In 1848, the revolutionary Government promoted him governor-general. He refused the post of minister of war because the Government would not fall in with his plan to occupy Paris by troops. Like L. A. Thiers, Cavaignac conceived the idea of drawing the "red republicans" of Paris out into open insurrection, in order that they might be crushed and the domination of the moderates secured. After the National Assembly had eliminated the Socialist members Louis Blanc and Albert (qq.v.) from the Government, Cavaignac was made minister of war. The revolt on which he had calculated broke out on June 22, 1848 (see *NATIONAL WORKSHOPS*). Cavaignac withdrew his troops from the affected parts of Paris, till, in his opinion, the revolt had gained sufficient head. He took advantage of the general panic, further, to insist on the resignation of the Government and the granting of dictatorial powers to himself, which was agreed on June 25. His attack on the Parisian rebels—who were exclusively working class, led to the bloodiest and most obstinate conflict that had up till then occurred in Paris; at its end, in his victory on the 26th, Cavaignac permitted, in accordance with his plan, the severest reprisals which decimated the ranks of the Socialists and broke their power.

Both he and his adversaries expected that after laying down his dictatorship he would be elected president. But they had not allowed for the magic of the name of "Louis Napoleon Bonaparte"; a "landslide" of peasant and proletarian votes gave 5,434,226 to the future Napoleon III. and only 1,448,107 to Cavaignac. The disappointed general went into opposition and at the time of the *coup d'état* (Dec. 2, 1851) was even imprisoned for a short while. After his release he abandoned politics and died in retirement on Oct. 28, 1857.

See Louis Menard, *Prologue d'une Révolution* (reprinted 1904); Ch. Schmidt, *Les Journées de juin 1848* (1926); P. de la Gorce, *Histoire de la 2de République* (1914); G. Renard, *La République de 1848* (1900-8); R. W. Postgate, *Revolution from 1789 to 1906* (1920, full bibliog.).

His son, JACQUES MARIE EUGÈNE GODEFROY CAVAIGNAC (1853-1905), French politician, was born in Paris on May 21, 1853. He served as a civil engineer in Angoulême until 1881, when he became master of requests in the Council of State. In 1882 he was elected deputy for Saint-Calais (Sarthe) in the republican interest. In 1885-86 he was under-secretary for war in the Henri Brisson Ministry, and he served in the cabinet of Émile Loubet (1892) as minister of marine and of the colonies. He had exchanged his moderate republicanism for radical views before he became war minister in the cabinet of Léon Bourgeois (1895-96). He was again minister of war in the Brisson cabinet in July 1898, when he read in the chamber a document which definitely incriminated Capt. Alfred Dreyfus. On Aug. 30, however, he stated that this had been discovered to be a forgery by Col. Henry, but he refused to concur with his colleagues in a revision of the Dreyfus prosecution, which was the logical outcome of his own exposure of the forgery. Resigning his portfolio, he joined the Nationalist group in the chamber, and became an energetic supporter of the Ligue de la Patrie Française. In 1899 Cavaignac was an unsuccessful candidate for the presidency of the republic. He died at his country-seat near Flée (Sarthe) on Sept. 25, 1905. He wrote an important book on the *Formation de la Prusse contemporaine* (1891-98), dealing with the events of 1806-13.

See J. M. Cavaignac, *Les deux généraux Cavaignac* (1897); A. Deschamps, *Les deux généraux Cavaignac* (1898); W. Arnoulm, *L'Action clericale en France, Les Cavaignacs devant l'histoire* (1905).

**CAVAILLON**, a town of south-eastern France in the department of Vaucluse, 20 mi. S.E. of Avignon. Pop. (1936), 8,452. It lies at the southern foot of Mount St. Jacques on the right bank of the Durance above its confluence with the Coulon. To the south of the present town lay the Roman *Cabellio*, a place of some note in territory of the Cavares. Since mediaeval times the town has for the most part followed the fortunes of the Comtat Venaissin, in which it was included. Till the Revolution it was the see of a bishop, and had a large number of monastic establishments. The church of St. Véran is a fine example of 12th century Provençal architecture, with a cloister adjoining. The town is the centre of a rich and well-irrigated plain, which produces fruits and early vegetables. Silk-worms are reared, and silk is an important article of trade. The preparation of preserved vegetables and fruits, distilling and the manufacture of straw hats and leather are carried on.

**CAVALCANTI, GUIDO** (c. 1250-1300), Italian poet and philosopher, was the son of a philosopher whom Dante, in the *Inferno*, condemns to torment among the epicureans and atheists; but he himself was a friend of the poet. By marriage with Beatrice, daughter of Farinata Uberti, he became head of the Ghibellines. He was banished to Sarzana, where he caught a fever, of which he died. Cavalcanti has left a number of love sonnets and canzoni, in honor of a French lady, whom he calls Mandetta. His complete poetical works are contained in Giunti's collection (Florence, 1527; Venice, 1531-32).

The most famous of his sonnets and canzoni are translated by D. G. Rossetti in his *Dante and his Circle* (1874).

**CAVALCASELLE, GIOVANNI BATTISTA** (1820-1897), Italian writer on art, was born at Legnago on Jan. 22, 1820. He became a student at the Academia delle Belle Arti in Venice, and from early youth studied the art treasures of Italy. His relations sent him to Padua, hoping that he might become an engineer, but in 1844 he returned to his artistic studies. He visited the cities of Tuscany, and then set out to see the masterpieces of Italian art in foreign countries. During a stay in Germany in 1846 and 1847 he made the acquaintance of Joseph Archer Crowe in a post carriage between Hamm and Minden. The two young men felt drawn to each other and met again in Berlin, where they studied together some pictures in the museum. On his return to Venice Cavalcaselle took an active part in the revolution of 1848 against the Austrian rule. He was arrested by Austrian gendarmes and narrowly escaped being shot. He then joined the forces of Garibaldi and was taken prisoner by the French in 1849. He arrived in a miserable plight in Paris, where by good fortune he again met Crowe, and with his help came to



London. The two friends occupied rooms together and worked on a history of early Flemish painters, published in 1857. In the same year Cavalcaselle returned to Italy. In 1864 Crowe and Cavalcaselle published their great work, *New History of Italian Painting*, which was followed by the *History of Painting in North Italy*. Other joint works were *Titian* (1876) and *Raphael* (1883). Cavalcaselle's independent writings are of less importance: *Sul più autentico ritratto di Dante* (1865); *Sulla conservazione dei Monumenti ed oggetti di belle arti*; *Sulle riforme dell' insegnamento academico* (1875).

Cavalcaselle was for some time secretary to the great art critic and collector, Giovanni Morelli, and his travelling companion when Morelli compiled the inventory of the works of art in the Marca d'Ancona for the Italian Government. Towards the end of his life Cavalcaselle held office as ispettore di belle arti in the Ministry of Education in Rome. He died on Oct. 31, 1897.

Crowe and Cavalcaselle's histories of Italian art are standard works, and have recently been re-edited by Langton Douglas and Tancred Borenius.

**CAVALIER, JEAN** (1681-1740), the famous chief of the Camisards (*q.v.*), was born at Mas Roux, near Anduze (Gard), on Nov. 28, 1681. His father, an illiterate peasant, had been compelled by persecution to become a Roman Catholic along with his family, but his mother brought him up secretly in the Protestant faith. Threatened with prosecution for his religious opinions he went to Geneva, where he passed the year 1701; he returned to the Cévennes on the eve of the rebellion of the Camisards, who by the murder of the Abbé du Chayla at Pont-de-Monvert on the night of July 24, 1702, raised the standard of revolt. Some months later he became their leader. He showed an extraordinary genius for war. Within a period of two years he was to hold in check Count Maurice de Broglie and Marshal Montrevel, and to carry on one of the most terrible partisan wars in French history.

He maintained the most severe discipline. Each battle increased the terror of his name. On Christmas day, 1702, he dared to hold a religious assembly at the very gates of Alais, and put to flight the local militia which came forth to attack him. At Vagnas, on Feb. 10, 1703, he routed the royal troops, but, defeated in his turn, he was compelled to find safety in flight. But he reappeared, was again defeated at Tour de Bellot (April 30), and again recovered himself, recruits flocking to him to fill up the places of the slain. Cavalier boldly carried the war into the plain, made terrible reprisals, and threatened even Nîmes itself. On April 16, 1704, he encountered Marshal Montrevel himself at the bridge of Nages, with 1,000 men against 5,000, and, though defeated after a desperate conflict, he made a successful retreat. Cavalier was induced to attend a conference at Pont d'Avène near Alais on May 11, 1704, and on May 16, he made submission at Nîmes. Louis XIV. gave him a commission as colonel, which Villars presented to him personally, and a pension of 1,200 livres. At the same time the king authorized the formation of a Camisard regiment for service in Spain under his command.

Before leaving the Cévennes for the last time he went to Alais and to Ribaute, followed by an immense concourse of people. But Cavalier had not been able to obtain liberty of conscience, and his Camisards almost to a man broke forth in wrath against him, reproaching him for what they described as his treacherous desertion. On June 21, 1704, with a hundred Camisards who were still faithful to him, he departed from Nîmes and came to Neu-Brisach (Alsace), where he was to be quartered. From Dijon he went on to Paris, where Louis XIV. gave him audience and heard his explanation of the revolt of the Cévennes. Returning to Dijon, fearing to be imprisoned in the fortress of Neu-Brisach, he escaped with his troop near Montbéliard and took refuge at Lausanne. But he was too much of a soldier to abandon the career of arms. He offered his services to the duke of Savoy, and with his Camisards made war in the Val d'Aosta. After the peace he crossed to England, where he formed a regiment of refugees which took part in the Spanish expedition under the earl of Peterborough and Sir Cloudesley Shovel in May, 1705.

At the battle of Almansa the Camisards found themselves opposed to a French regiment, and without firing the two bodies rushed one upon the other. "I fought," Cavalier wrote on July 10, "as long as a man stood beside me and until numbers overpowered me, losing also an immense quantity of blood from a dozen wounds which I received." Marshal Berwick never spoke of this tragic event without visible emotion.

On his return to England a small pension was given him. He settled at Dublin, where he published *Memoirs of the Wars of the Cévennes under Col. Cavalier*, written in French and translated into English with a dedication to Lord Carteret (1726). He was made general on Oct. 27, 1735, and on May 25, 1738, was appointed lieutenant-governor of Jersey. He was promoted major-general in July, 1739, and died in the following year.

See N. A. F. Puaux, *Vie de Jean Cavalier* (1868); David C. A. Agnew, *Protestant Exiles from France*, ii. 54-66 (1871); Charvey, *Jean Cavalier: nouveaux documents inédits* (1884). Eugène Sue popularized the name of the Camisard chief in *Jean Cavalier ou les janatiques des Cévennes* (1840). A new edition of Cavalier's *Mémoires sur la guerre des Cévennes* was published by F. Puaux in 1918.

**CAVALIER**, a horseman, particularly a horse-soldier or one of gentle birth, trained in knightly exercises. The word is taken through the French from the Late Lat. *caballarius*, a horseman. *Chevalier*, the French word of parallel descent, means "knight," and is chiefly used in English for a member of certain foreign military or other orders, particularly of the Legion of Honour. Cavalier in English was early applied in a contemptuous sense to an overbearing swashbuckler. Originally used as a term of reproach, it was soon adopted as a title of honour by the supporters of Charles I. in the Great Rebellion, who applied Roundhead to their opponents, and at the Restoration the court party preserved the name, which survived till the rise of the term Tory (*see* WHIG AND TORY). The term "cavalier," in fortification, means a work of great command constructed in the interior of a fort, bastion or other defence, so as to fire over the main parapet without interfering with its firing. A greater volume of fire can thus be obtained, but the great height of the cavalier makes it an easy target for a besieger's guns.

**CAVALIERI, BONAVENTURA** (1598-1647), Italian mathematician, was born at Milan; his name also occurs in the forms Cavallieri, Cavaglieri, Cavalerius, and de Cavalerius. He became a Jesuit at an early age and later was inspired to study mathematics by reading a copy of Euclid. On the recommendation of his Order he was made a professor at Bologna in 1629; the post, which he held until he died, was renewed periodically. In 1635 Cavalieri wrote *Geometria indivisibilium continuorum nova quadam ratione promota*, in which he first stated his principle of indivisibles. The form of the principle was unsatisfactory and was attacked by Guldin. In reply to this attack Cavalieri wrote *Exercitationes geometricae sex* (1647), stating the principle in the more satisfactory form in which it was used by 17th century mathematicians. This work also contained the first rigorous proof of Guldin's theorem relating to the volume of a solid of revolution. The theorem had occurred in the writings of Pappus and had been used in an unsatisfactory fashion by Kepler. Using the principle of indivisibles as a sort of integral calculus, Cavalieri solved a number of problems proposed by Kepler. Other books by Cavalieri are: *Lo specchio istorico ovvero trattato delle settioni coniche* (1632), *Directorium generale uranometricum, in quo trigonometriae logarithmicae fundamenta ac regula demonstrantur* (1632) and *Trigonometria plana et sphaerica* (1643). Cavalieri died at Bologna on Dec. 3, 1647.

The life of Cavalieri has been written by P. Frisi (Milan, 1776), and by F. Predari (Milan, 1843).

**CAVALIERI, EMILIO DEL** (1550?-1599?), Italian composer, was born in Rome about 1550 of a noble family and became one of the famous Florentine group of musical reformers—Peri, Rinuccini, Caccini and the rest—who had such an important influence on the subsequent developments of the art.

Cavalieri's style is more facile than that of Peri and Caccini, but he is inferior to them in depth of musical expression. He is, however, important as having been the first to apply the new monodic style to sacred music, and as the founder of the Roman

school of the 17th century which included Domenico Mazzocchi, Giacomo Carissimi and Alessandro Scarlatti.

**CAVALLI, FRANCESCO** (1602–1676), an early Italian operatic composer of note, was born at Crema in 1602. His real name was Pietro Francesco Caletti-Bruni, but he is better known by that of Cavalli, the name of his patron, a Venetian nobleman. He became a singer at St. Mark's in Venice in 1617, second organist in 1639, first organist in 1665 and in 1668 *maestro di cappella*. He is, however, chiefly important for his operas, 27 of which are still extant, most of them being preserved in the library of St. Mark's at Venice.

Claudio Monteverdi had found opera a musico-literary experiment, and left it a magnificent dramatic spectacle.

Cavalli succeeded in making it a popular entertainment. He reduced Monteverdi's extravagant orchestra to more practical limits, introduced melodious arias into his music and popular types into his libretti. His operas have all the characteristic exaggerations and absurdities of the 17th century, but they have also a remarkably strong sense of dramatic effect as well as a great musical facility and a grotesque humour which was characteristic of Italian grand opera down to the death of Alessandro Scarlatti.

**CAVALLINI, PIETRO** (c. 1259–1344), Italian painter, born in Rome, was taught painting and mosaic by Giotto di Bondone while employed at Rome; it is believed that he assisted his master in the mosaic of the Navicella or ship of St. Peter, in the porch of the church of that saint. He also studied under the Cosmati. Luigi Lanzi describes him as an adept in both arts, and mentions with approbation his grand fresco of a crucifixion at Assisi, still in tolerable preservation; he was, moreover, versed in architecture and in sculpture.

According to George Vertue, it is highly probable that Cavallini executed, in 1279, the mosaics and other ornaments of the tomb of Edward the Confessor in Westminster abbey. Cavallini would thus be the Petrus Civis Romanus whose name is inscribed on the shrine; but a comparison of dates invalidates this surmise.

He died in 1344 at the age of 85. Some important works by Cavallini in the church of Santa Cecilia in Trastevere, Rome, were discovered early in the 20th century.

**CAVALLOTTI, FELICE** (1842–1898), Italian politician, poet and dramatic author, was born in Milan. In 1860 and 1866 he fought with the Garibaldian corps, but he first attained notoriety by his antimonarchical lampoons in the *Gazzetta di Milano* and the *Gazzetta Roas* between 1866 and 1872. Elected to parliament in 1872, his turbulent eloquence secured for him the leadership of the extreme left in 1886 on Agostino Bertani's death. His advocacy of democratic reform made him the most popular man of his day next to Francesco Crispi, against whom he waged an unceasing and bitter campaign. He was killed in a duel with Count Macola.

See A. de Mohr, *Felice Cavallotti: La Vita e le opere* (Milan, 1899).

**CAVALRY**, known in most armies after World War II as armoured cavalry, constitutes one of the major ground combat arms of a military force and is the element the main duties of which are to furnish full terrestrial information of the enemy while screening the movements of its own army; to pursue and demoralize a defeated enemy; at all times to threaten and intercept his communications (lines of supply and command); in battle to strike suddenly and swiftly at weakened points, turn exposed flanks or force or exploit a penetration or breakthrough. While it could fight dismounted, cavalry originally was considered as an arm which fought on horseback, using the horse's mobility in manoeuvring and his impetus in charging.

By the middle of the 16th century the term cavalry was applied to mounted men of all kinds employed for combatant purposes. Cavalry missions have always required a high degree of mobility, and during the early part of the 20th century, in order to accomplish assigned tasks, the arm adopted fast-moving armoured vehicles. Cavalry operating entirely in armoured fighting vehicles became known as "mechanized cavalry" and subsequently as "armoured cavalry." The weapons of the armoured cavalry are tanks, self-propelled guns and howitzers, automatic weapons, mor-

tars, rocket launchers, rifles, pistols, bayonets and grenades.

The U.S. army organization act of 1950 eliminated cavalry as a branch and provided for an armour branch, "a continuation of the cavalry."

**History of Cavalry Tactics.**—The two most primitive types of soldier are the foot soldier and the horse soldier, the first being characteristic of early European warfare, and the second of early Asiatic warfare, since in southern Europe (that is, in the countries south and west of the Danube and the Rhine) few suitable breeds of war horses existed—hence the poverty of Roman cavalry and of early Grecian cavalry. When infantry met infantry, battles were decided by numbers or armament or discipline; and when cavalry met cavalry, as in Scythia, battles were seldom decided at all, degenerating as they normally did into skirmishes, forays and scattered pursuits. In hilly country, such as most of Greece, cavalry were normally impotent to attack infantry, as is exemplified in the Graeco-Persian Wars (490–479 B.C.); while in open plain land, so frequently found in Asia Minor, they could destroy infantry by besieging them in the field, as happened to Crassus, at Carrhae in 53 B.C. The truth of the matter is that the two arms were complementary, each providing the other with powers not inherent in either separately. Infantry in an advance were useless unless their rear services were protected, and so also were cavalry in the advance, unless the positions won by them could be held so that their forward movement might not be interrupted.

The art of an advance through a hostile country has always pivoted on the power of pushing forward a secure and movable base in order to develop from it offensive power. Once infantry and cavalry were combined, the first formed the movable base, and the second provided the offensive power. The function of cavalry in any armed force was to fill that requirement of a balanced army which demands a fighting ground element superior to the main element—infantry—in mobility near and on the battlefield, and possessing in common with that arm the ability to engage in offensive and defensive fighting, whether independently or in conjunction with other arms.

When the advance merged into the attack, three targets would present themselves; namely, the enemy's infantry, his cavalry and his baggage train. If the third could be seized and held, the severest possible blow could be dealt the enemy's organization; consequently the supply services would be well protected by the battle front. Infantry could oppose infantry frontally, but if attacked in flank, or rear, by infantry or cavalry, they were taken at a tremendous disadvantage. Throughout history flank protection was furnished by cavalry. The infantry front may then be pictured as a slowly moving wall behind which were assembled the supply services, and on the flanks of which were hinged two cavalry wings, which, like doors, could swing forward and backward, "flapping" away any hostile force which might attempt to raid the baggage train, or attack the infantry in the rear. In battle, the first problem was, therefore, the destruction of one or both of the hostile cavalry wings, for when once the opposing infantry wall was bereft of its swinging doors, not only did its flanks become attackable, but also its rear. If, meanwhile, its front could be so firmly held that it was unable to change front, a cavalry attack on its flanks, or rear, was likely to prove decisive. In brief, the object of infantry was to provide a base of operations for cavalry; and the power of cavalry was to be sought, first in ability to overcome their like, and second in being able to develop a sufficiency of speed so as to circumvent an infantry front, and attack it in the rear before it could face about, which, in the case of an organized army, was an extremely difficult and dangerous operation; impossible if the front was firmly held.

**Early Cavalry.**—During the early classical age tactical organization was based on the nature of the country rather than on any idea of weapon co-operation or combination between the arms. Thus, in Sparta there was practically no cavalry, while in Scythia mounted bowmen alone existed. Nevertheless, as soon as the Asiatic horsemen came into contact with European foot soldiers, as took place in the 5th century B.C., the problem of tactical co-operation, namely, how to equip, arm and manoeuvre a body of men so that offensive power may be developed from a protec-

tive base, was thrust to the fore. This problem was solved by Philip of Macedon, and proved out by his son Alexander the Great.

The backbone of Philip's army was the phalanx, or infantry mass. Armed with the Sarissa, a pike from 18 to 21 ft. long, it formed an impenetrable hedge of spears to cavalry attack, though it offered a somewhat vulnerable target to archers both mounted and on foot. To protect it from these, numbers of lightly armed infantry were attached to it, their duty being very similar to that of the British light infantry during the Peninsular War in Spain at the beginning of the 19th century. Recognizing the strong protective and resisting power which the phalanx possessed, Philip was one of the first among the ancients to grasp the fact that stability of organization alone is insufficient to guarantee the act of disruption being followed up by the act of annihilation. The phalanx could not pursue without breaking its formation, it was not armed for the pursuit, and in the pursuit, the pursued almost invariably moves faster than the pursuer, whether both be on foot or mounted. To render the act of annihilation possible, Philip added to the phalanx a superb force of cavalry in the proportion of one trooper to every six heavy foot soldiers. This cavalry he organized in three bodies: Heavy armoured cavalry for the charge, his Companion cavalry being the most notable corps; light cavalry, or Hussars, for reconnaissance and outpost work, and Dragoons who could fight on foot or on horseback. His heavy cavalry doctrine was profoundly simple—horse and rider combined were used as a "projectile" against the enemy once he was held by the phalanx, when the object of his cavalry became the annihilation of all resistance. The tactics which his son developed from this organization were equally simple, and astonishingly effective. Advancing in parallel order to his enemy, he obliqued his right, bringing it forward, and while his centre, protected on its left by the left cavalry wing, held the enemy to his ground, he delivered a series of terrific punches at his opponent's centre, or left, with a view to penetrate or envelop. At the battles of the Granicus (334 B.C.), Issus (333 B.C.), and Gaugamela (331 B.C.) his Companion cavalry decided the day, and at the battle of the Hydaspes (326 B.C.) his cavalry so completely dislocated the Indian Army that his phalanx was able to disrupt it.

**Cavalry as the Decisive Arm: 327 B.C.—Adrianople, A.D. 378.**—From the days of Alexander onwards, cavalry, on account of their mobility, became the decisive arm. Hannibal's use of cavalry was superb, as the battles of the Trebbia (218 B.C.) and of Cannae (216 B.C.) testify. In both of these the Carthaginian cavalry completely dislocated the Roman legions by a rear attack. In the Roman armies the lack of good cavalry proved their ruin, and it was not until such a force was raised and trained by Scipio Africanus that the Carthaginians were eventually defeated at the battle of Ilipa (205 B.C.), and annihilated at that of Zama (202 B.C.). At Ilipa Scipio beat Hasdrubal by a double envelopment carried out by infantry and cavalry, and at Zama he smashed Hannibal by holding him in front with infantry and striking him in rear with cavalry.

During the days of Julius Caesar, the most serious defeat sustained by the Romans was that of Crassus at the hands of Surena, the Parthian general, whose entire force was composed of mounted archers and heavy cavalry. The Parthians, adopting an improved form of Scythian tactics, won a decisive victory; of the 40,000 Romans who crossed the Euphrates 20,000 were killed and 10,000 made prisoners. The Parthian success was due to the inability of the Romans to develop offensive power from a moving base. Their organization did not enable them to ward off shock and envelopment, while that of their enemy did permit of them enveloping and charging; for in this battle their heavy cavalry provided the necessary stability for the attack of their mounted bowmen and the distraction effected by this attack enabled the heavy cavalry of the Parthians to dislocate and disrupt the Roman legions.

From the battle of Pharsalus (48 B.C.) the legion learned for a space how to hold its own against cavalry, mainly by employing cavalry. Under Diocletian (A.D. 245–313) cavalry rose from one-tenth to one-third of the infantry, and numbered some 160,000; but this great mass of horse was withdrawn from the infantry, and

by being formed into a frontier guard lost its offensive spirit. Meanwhile a steady decline took place in the infantry, mercenaries were enlisted, discipline was relaxed, pay increased and armour discarded because of its weight. Of the latter Vegetius wrote: ". . . to avoid fatigue, they allow themselves to be butchered shamefully like cattle." This separation of infantry and cavalry was the main tactical cause of the decline of Rome's military power. The unsupported Roman cavalry, trained as frontier police and for protective duties, were no match for the fierce barbarian horsemen who were now distracting the empire. From the first irruption of the Goths, in the year 248, the Roman cavalry were steadily increased until by the reign of Constantine (288–337) cavalry composed the principal part of the Roman armies; but all in vain. At Adrianople in 378, three Roman legions sent against the Visigoths were overwhelmed and practically annihilated. The Gothic horsemen, *having perfected a new-fangled stirrup*, rode and fought with a vigour and deadliness new to the mounted warrior. Caught massed under a blazing sun, the Roman flank was struck relentlessly by the Gothic horse, and again the dislocation of the Romans, which heralded their disruption, was effected by a cavalry rear attack. The Emperor Valens lost his life, and 40,000 legionnaires perished. From that day cavalry was to become the predominant arm for a thousand years, while the infantry deteriorated into a mere auxiliary.

**Cavalry the Predominant Arm: Chalons, 451—Agincourt, 1415.**—Fifty-two years after Adrianople, Roman arms at Tricameron won a decisive victory over the Vandals in Africa purely by cavalry. Belisarius had found so little use for his infantry that he mounted them to serve as dragoons. In Europe, however, the hardy and warlike barbarian tribes, fighting chiefly on horseback, soon flooded the Roman provinces. By 410 A.D., the Goths under Alaric captured Rome, and the "mistress of the world" was handed over to the licentious fury of the Huns. The barbarian advance culminated in the battle of Chalons (451) where Attila, after uniting Germany and Scythia, was met and defeated by Aetius and Theodoric. This was the last victory won by Imperial Rome in the West; the dark ages descended upon western Europe, and in the conduct of war that area entered the epoch of the iron-clad lancer.

From the days of Justinian (483–565) to those of the fourth Crusade, which resulted in the sack of Constantinople (1204), highly organized armies comprising well-equipped heavy and light cavalry were maintained by the Eastern empire. In the West, however, military art virtually disappeared, and as principalities took form and feudalism was established the common folk were virtually prohibited from taking part in the "noble" trade of war, which was carried on by raiding and pillaging barons. As the military caste of this period was based on wealth, and as western Europe was largely roadless, cavalry remained the predominant arm, and sought perfection not through improved tactics, or organization, but through armour. By the opening of the 9th century the old military organization of Rome had been replaced by comparatively small bands of mailed knights followed by a mob of retainers who pillaged the countryside and so acted as "administrative units." In England, in the Low Countries and in Switzerland, infantry were still maintained, but were so ill-equipped that when confronted by cavalry in open, or even semi-open, country they were forced to seek protection behind palisades, as was the case with the Saxons at Hastings (1066). Under Charlemagne the mail-clad knight was reaching his zenith, and, as is always the case when the peak of supremacy is topped, decline follows. To the knight of the middle ages the protective base of his offensive power was no longer afforded by the infantry mass, but by the armour he wore, his mobility being provided by his horse. As long as he was not met by equally well mounted and armoured antagonists this combination of mobility and protection proved tactically irresistible, yet seldom did it lead to profitable strategic results. But as soon as he was, it became neutralized, and with neutralization, tactics as an art utterly deteriorated and were replaced by mob fighting.

This self-contained protective power of cavalry is most noticeable during the Crusades, for in spite of the low discipline of the



Christian knights and their very rudimentary knowledge of tactics, normally their casualties were remarkably small. At the battle of Hazerth (1125), Baldwin lost only 24 men, while the Turkish losses amounted to 2,000; at Jaffa (1191) two Crusaders were killed on one side and 700 Turks on the other. The Crusaders, however, lost large numbers of horses, and as the rabble of beggars and vagrants who accompanied them were useless as infantry (further, the code of chivalry did not sanction their use), at times it became necessary for knights to fight on foot, or to abstain from fighting altogether. This involuntary change in tactics led to the Crusaders rediscovering the value of the protective infantry base as a mobile fortress from which the mounted knights could sally forth. In 1248, St. Louis of France adopted this change intentionally. Near Damietta he landed his knights and drew them up on foot in order of battle to cover his disembarkation. The interesting point to note in these operations is that the action of these knights foreshadowed the approaching revival of infantry: "They formed up in serried ranks, placed their bucklers upright in the sand before them, and resting their long lances on the top of their shields, presented an impenetrable array of steel points, before which the Muslim horse fell back in confusion." One of the military influences of the Crusades was the weakening of feudalism through the rise of a commercial class made rich by buying up the knights' lands. This class was concentrated in the cities, and as early as 1057 Pavia and Milan raised armies of their own, largely composed of infantry.

Another result of increasing prosperity was the reintroduction of plate armour, which though it rendered the knight on foot practically invulnerable to infantry attack, when mounted, more and more did it sacrifice his mobility to protection. This seriously influenced the value of the dismounted base, for armour had become so heavy that the dismounted knight was unable to move far on foot. At the battle of Tagliacozzo (1268), Conradin's Ghibelline knights were so heavily armoured that Charles of Anjou's cavalry, after having exhausted them by repeated charges, rolled them out of their saddles by seizing them by their shoulders.

With signs of cavalry power diminishing in the West, there appeared in the East the very essence of power by the mounted warrior. In the latter part of the 12th century there arose on the plains of Mongolia the most formidable cavalry warrior of human annals—Genghis Khan. Utilizing the horsemanship and spirit of conflict which permeated the character of his people, he created vast organized mounted hordes which swept the entire northern and eastern areas of Asia. It is alleged that a mounted force of 700,000 men, held together by a discipline of unyielding iron, rode to his will. Death was the penalty for turning back during action without an order or for neglecting to pick up equipment dropped by a front-file man. From a penetrating native perception, the Khan conceived the powers of co-ordinated and disciplined cavalry. Vigilant and ceaseless training perfected a standard for tactical measures. "A man of my bodyguard," Genghis Khan had announced, "is superior to a regimental commander of another division." The tactical skill of the Mongols had been developed in the stress of war. They had learned to keep track of an enemy's movements while concealing their own. In manoeuvre for battle they had learned not to depend on commands given by a voice which often cannot be heard in the uproar of moving mounted men. Regiments signalled their movements by raising black or white flags during the day and by a similar use of coloured lanterns at night. Other signals were given by the use of whistling arrows, which emitted sound through a hollow pierced head. They hid their formations at times behind a drifting smoke screen. The Mongol horde, unlike the Crusade, formed a movement of deadly intensity by virtue of its disciplined co-ordination and cohesion towards a common end. Followed by immense trains of wagons and great herds of cattle, they could exist for years off the country invaded. They crossed rivers on ice or in leathern boats. They fought mainly with arrows, avoiding close struggle, and strove to destroy their enemies from afar with projectile weapons. There was a fluidity and flexibility in their movements found wanting in the fixed, cumbersome ranks of European forces.

After the death of the great Khan, 150,000 Mongols under the

able Sabutai, in 1235, marched towards the setting sun and threatened to flood the whole of Europe. In the next six years this enormous horde had marched one-fourth the distance around the globe. Sabutai swept through present day Russia and on to the plains of Hungary and Poland. Eastern Europe, from the Carpathians to the Baltic, fell under his domain. Although victorious in their fierce battle with the Poles at Wahlstall in April 1241, the strength of the invading Mongols had been so taxed that they turned back to the East. The leaders of western Europe learned little concerning the capacity of highly mobile cavalry in great numbers presented to them by the Mongolian mounted men.

Meanwhile, in western Europe progress in the construction of the bow and the crossbow was another reason for increasing the thickness of armour. At the siege of Abergavenny, in 1182, it is recorded that the Welsh arrows could penetrate an oak door four inches thick. No chain mail could withstand such a blow, consequently plate armour was worn over the mail shirt. As armour increased in weight natural obstacles began to play a decisive part on the battlefield. When ground could not be crossed on horseback it had to be crossed on foot, and the knight deprived of his horse lost much of his tactical value, consequently an able enemy sought every means in his power to compel him to dismount. One of these means was choice of ground, another, archery; for horse armour never proved satisfactory.

At the battle of Dupplin Muir (1332), Baliol and Beaumont did not beat the earl of Mar by reckless charges, but by skillful weapon co-operation. The majority of their knights were dismounted and formed into a phalanx, the flanks of which were protected by archers, while 40 mounted knights were kept in reserve. The earl of Mar charged the phalanx which remained unshaken; his knights, immobilized by the archers on the flanks, were routed by Baliol's mounted squadron. This battle is the birth of a new era in tactics—the tactics of bow, pike and lance combined. It formed the mould in which all the English operations of the Hundred Years' War were cast, a war which proved disastrous to the gallant but insubordinate French chivalry, as the battles of Crécy (1346), Poitiers (1356), and Agincourt (1415) testify. The cavalry difficulty throughout was the armouring of the horse. At Crécy (where gunpowder was first introduced) the horse proved the weak link in the French organization, for of the next great battle, namely Poitiers, John le Bel wrote of the French knights: "All fought on foot, through fear that, as at the battle of Crécy, the archers would kill their horses." Meanwhile in Switzerland infantry armed with pike and halberd, and fighting in phalangeal order, were taking toll of German and Austrian cavalry; and in Bohemia, Ziska by employing wagons in laager created movable fortresses known as the Wagenburg (wagon fort) against which his enemy's cavalry shattered themselves in vain. As wealth increased, mercenaries once again came to the fore, and being professional soldiers whose pay as well as whose lives depended on their art, tactics once again began to assume a coherent form, especially under the English commander-in-chief of Pope Urban V, Sir John Hawkwood, who may be considered the first great general of modern times. From the battle of Poitiers onwards cavalry fell into a rapid decline; the French knights learned nothing, and as the bow and pike destroyed them a new weapon arose in the crude bombards of the 14th century, which was destined to revolutionize the whole art of war, to reduce cavalry to the position they held in the days of the Scythians, and to advance infantry to the heyday of the Spartan phalanx. At the battle of Formigny (1450), three small culverins threw the English archers into disorder, and at Morat (1476) Charles the Bold of Burgundy was defeated by the Swiss who made good use of 6,000 hand guns.

**Cavalry in the Age of Gunpowder.**—For 1,000 years cavalry had sought to solve the problem of mobility through protection by armour. This being no longer possible, because armour could be penetrated by the bullet, after much trial and error a solution was sought through fire-power (the very cause of its obsolescence), that is to say, by combining cavalry with the other arms. In 1494, Charles VIII of France entered Rome, and in the words of Machiavelli: "He conquered Italy with a piece of chalk."

Arming a tenth of his infantry with the escopette, a species of arquebus, and accompanied by 140 heavy cannon and a number of small pieces, nothing could resist him, and so all he had to do was to chalk off areas on the map to which he wished to go, and there he went.

As armour grew lighter the knight exchanged his lance for the petronel, a type of hand cannon, in order to fire on infantry in place of charging them. This form of attack was first used by the French at the battle of Cerisoles, in 1544, and proved effective because the attack could be prolonged indefinitely, and against such organized Scythian tactics the infantry were powerless until the arquebus was improved, when cavalry became more immobile than ever. Soon the petronel was replaced by the arquebus-à-routet, and a little later on by the wheel-lock pistol, which was first used by the German cavalry at the battle of St. Quentin, in 1557.

The lance now vanished, and attempts were made to develop cavalry mobility by mixing squadrons with infantry units. As early as the battle of Pavia (1525), the Marquis of Pescara had adopted this organization, and though in a clumsy way it linked fire-power and shock, the mobility of cavalry was so limited by the pace of the infantry that the cavalry attack was reduced to a walk. Twenty-five years after this battle, Marshal de Brissac mounted a number of his infantrymen on horseback, and the era of the modern Dragoon, or mounted infantryman, was initiated.

During the Thirty Years' War (1618-48) the employment of cavalry increased, cavalry mobility being sought not through their own fire power but through that of infantry, and especially artillery. Supported by artillery, Gustavus Adolphus' cavalry rode forward, fired their pistols and charged home with the sword. At Breitenfeld (1631) and at Lutzen (1632) his cavalry played the decisive part. In England he was emulated by Cromwell—the battle of Grantham (1643) was decided by the sword, so was Marston Moor (1644), and so was Naseby (1645). In France the reversion to shock tactics was no whit behind-hand: Turenne favoured the *arme blanche*, and issued instructions to his cavalry to use the sword alone. The impetuous Condé did likewise, and so also Marshal Luxembourg at Leuze, in 1691. In Germany, however, Montecuculi still favoured fire-arms for cavalry; he considered the lance useless, and looked upon the horses of his Dragoons solely as a means of conveyance.

This change is significant and cannot alone be attributed to the genius of such cavalry leaders as Pappenheim and Gustavus. The underlying reason for it is probably to be found in the universal adoption of the matchlock, and the consequent reduction of the pikemen. The matchlock was a slow-loading and unreliable weapon, especially in rainy weather when infantry are apt to be surprised in mist or fog. It was on such occasions as these that cavalry frequently proved themselves the decisive arm, up to the adoption of the percussion cap in 1839. A notable instance of this was the battle of Eylau (1807). During the 18th century the idea of the shock continued to grow. Marlborough used cavalry in mass. Blenheim (1704) was decided by cavalry, and so was Malplaquet (1708). In these battles are to be discovered the germ of the superb cavalry actions of Ziethen and Seydlitz, which characterized the Seven Years' War (1756-63). Charles XII of Sweden carried the shock to its extreme. He prohibited the use of armour, raced over Europe, rode to death two horses while reviewing a regiment, and met an impetuous end at Pultowa (1709). Marshal Saxe, in a reasoned degree, emulated him.

Under Frederick the Great, cavalry once again reached its zenith, and out of 22 of his battles at least 15 were won by the cavalry arm working in close co-operation with gun and musket. In his regulations for cavalry Frederick wrote: "They will move off at a fast trot and charge at the gallop, being careful to be well closed together. His Majesty will guarantee that the enemy will be beaten every time they are charged in this way." The exploits of Seydlitz and Ziethen proved that Frederick was not wrong. Rosbach (1757) was a great cavalry victory, and so, in a lesser degree, was Zorndorf (1758). The secret of Frederick's success lay not only in the artillery preparation which heralded the charge, nor in his system of attack, but in the training of his troopers.

The war of the American Revolution (1775-81) provides no example of outstanding cavalry work, nor do the French Revolutionary Wars, except for the brilliant charge of the English 15th Hussars at Villers-en-Couché (1794), where some 300 British and Austrian cavalry charged and routed 10,000 French infantry and cavalry, driving them into Cambrai with a loss of 1,200 men. The slowing down of the shock first became perceptible in Bonaparte's campaign in Egypt, when the world-famed Mameluke cavalry failed to make any real impression on his infantry squares. At Mount Tabor (1799) 6,000 French infantry under Kléber gained a decisive victory over 30,000 Turks and Mamelukes. From this battle onwards to the World War of 1914-18 the declining power of cavalry remains constant.

Napoleon relied on all arms, but particularly on fire power, and in spite of the many cavalry charges executed during his wars, his cavalry were pre-eminently a strategic force for observation and protection, and a tactical force for pursuit. With his strategic employment of cavalry, no commander was ever more completely informed at all times of the movements and composition of the hostile army than was Napoleon. His earlier manoeuvres, conceived after a careful synchronization of time and space factors, were made practical by skillfully led cavalry. Far-flung columns, well in advance of his main armies, not only kept him posted of hostile movements but were influential in manoeuvring an enemy into an area of Napoleon's own selection. Once contact was gained by main bodies, cavalry invariably were withdrawn to flanks or to the rear in reserve. While mounted charges were executed, they were made at that period in battle when the enemy was shattered by fire and the keen discernment of Napoleon foresaw conclusive results. From the flanks and rear his cavalry were able to deliver the decisive thrust or spring in pursuit of a routed enemy, which meant destruction rather than an orderly retirement and the ability to fight again after reorganization. At Eylau (1807) Napoleonic cavalry, encountering the Russian Cossacks, were confronted for the first time by a mobile element of their own quality; pursuit proved impossible, and strategic reconnaissance ineffective. In the Emperor's subsequent campaigns of 1812-13-14, superior enemy cavalry nullified any real fruits of victory, and in the retreat from Moscow were responsible mainly for the gradual disintegration of the Grand Army. The freedom of manoeuvre, the basis of Napoleon's success, had been reversed.

The Napoleonic wars were followed by 40 years of profound military coma. In 1823, Capt. John Norton, of the 34th English Regiment, invented the cylindro-conoidal bullet. He received no encouragement, for the duke of Wellington considered that the Brown Bess could not be bettered, yet Norton's bullet was the greatest military invention since the flint-lock. In 1853, Capt. Minié, of the French army, invented a similar projectile. In England, Sir William Napier opposed its adoption as he considered that it would destroy the infantry spirit by turning infantry into "long range assassins." It was, however, adopted; it had a range of 1,000 yds., and it sealed the doom of the cavalry charge. The war in Crimea (1854-55) taught soldiers nothing new regarding cavalry except to emphasize its misuse by ill-informed commanders of combined arms and to demonstrate the gallantry and spirit of the arm. The battle of Balaklava gave to the world only the famed epic of "The Charge of the Light Brigade" and evidence of the magnificent courage, discipline, and combative will to close with an enemy characteristic of the British mounted warrior. (J. F. C. F.; J. K. H.; X.)

**The Mounted Rifleman.**—In the next war, the American Civil War (1861-65), a pronounced transition in cavalry tactics took form. The evolution of its tactics switched radically from the accepted European tenets of that day. The Confederate States, largely rural and agricultural, were able to create promptly a considerable cavalry to be used in strictly cavalry rôles. The Union, largely of urban population, organized cavalry at a slower pace, and employed it, initially, on the futile assignments of outpost, convoy, messenger and other associated activities. Employing cavalry in large units, Lee, in Virginia, was able to reap the benefit of decisive victories during the first two

years of the war; his own intentions were always screened from the enemy, while their movements and dispositions habitually were known to him. By May 1862, the Union, finally awake, assembled 10,000 horses into a cavalry corps. At Chancellorsville this formidable cavalry force was dispatched southward on a useless raid. Lee's cavalry, under James Stuart, discovering an open flank on the Union right, skilfully screened the movement of Thomas ("Stonewall") Jackson's corps, which launched a powerful surprise attack resulting in one of the most complete victories of Confederate arms. By 1863 cavalry tactics on both sides had become concerned principally with dismounted action and proved so effective that the mounted charge was a rarity thereafter. The eventual defeat of Lee was made possible in part through the able employment of a highly mobile cavalry and infantry force under Philip Sheridan. Repeated attacks against the Confederate lines of supply effected their dislocation by depriving them of a protected base. Increased powers of weapon fire had forced a new development of the cavalry dragoon or mounted rifleman—not to be confused with mounted infantry, which utilizes horses only as transportation and habitually fights dismounted; the mounted rifleman is trained and equipped to fight either dismounted or mounted. The revolver, introduced in this war, had proven a formidable cavalry weapon.

The wars which followed in Europe in 1866 and 1870 were marked by a complete disregard of the cavalry lessons learned from the American Civil War. The Austro-Prussian War (1866) saw 56,000 cavalymen still armed with the lance and sabre charging in the face of the breech-loading needle gun and the Minié rifle. The Franco-German War (1870-71) saw 96,000 cavalry take the field similarly equipped. Their tactics called only for mounted action. French cavalry had learned nothing since Waterloo. The Germans were bold and pushful, using their cavalry strategically with considerable effect in order to cover their own movements while discovering those of the enemy. The massed charge was attempted. Jean A. Margueritte failed; Adalbert von Bredow succeeded, but at terrific cost. His was the last successful massed boot-to-boot cavalry charge in military history.

In South Africa (1899-1902) the Boers, accepting the lessons of the American Civil War, fought with large numbers of mounted riflemen who moved hither and yon, came and went, attacked and retired almost at will. The British faced this type of action initially with a force in which infantry predominated and included a few cavalry regiments armed with swords or lances and depending mainly on these weapons for combat. Not until British mounted elements were reorganized on a dragoon basis were the British able to conquer a people immeasurably their inferior in numbers and resources.

In the Russo-Japanese War (1904-05) cavalry action of little consequence occurred. The outstanding note was the absence of the lance and sword, which were nowhere seen. In combat, the rifle was supreme; any thought of reliance on the sword was banished. The few achievements of Russian cavalry in this war came through the effect of fire action. Little use was made of the cavalry masses of Alexei Kuropatkin organized and equipped on the European model of massed action. Japanese cavalry, with few exceptions, carried out their performances with the carbine and usually in close touch with their own infantry.

**World War I.**—During World War I, little use was made of the potential power of cavalry available to both sides. The limitations which the bullet placed on cavalry movement begot the trench; for had cavalry been able to move, the construction of entrenched fronts would have been all but impossible. On the western front, ten German cavalry divisions (approximately 70,000) faced ten French and one British cavalry divisions. The tool was there for the appearance of a master of the art of war capable of visualizing the power and capabilities of a numerous cavalry on missions of inspired and skillful design. There was need for mounted riflemen, not the European cavalry of that day relying principally on the sword and lance in mounted action. The French cavalry were split into useless detachments, and the only sizable force, under Sordet, was marched futilely over the whole of southern Belgium\* and northern France; his operations availed nothing. The single British cavalry division, operating collectively as a unit, rendered inval-

able assistance to the main forces by employing ground fire to delay the German advance south of Mons until reorganization behind them was effected. While their grand plan conceived a powerful enveloping thrust southward through northwestern France, the Germans made little use of the potential power of their cavalry to aid that operation. The bulk of their mounted forces was scattered over the fronts of several field armies rather than assembled for a decisive effort.

On the eastern front, Russia produced initially 24 cavalry divisions (approximately 200,000 horsemen), but like the leaders of ancient Rome, the Russian commanders expended the potential power of this force by scattering it along an entire frontier. The armies of Alexander Samsonov and Paul Rennenkampf invaded East Prussia with forces totalling 400,000 combined arms to meet the most crushing defeat of the war at Tannenberg. The decisive victory of the Germans was made possible largely by the success of a single German cavalry division in delaying the army of Rennenkampf. Later, Russia increased its cavalry to 54 divisions; but with military leaders unable to cope with the requirements of massed co-ordination, this vast force accomplished little. It was, indeed, the indirect cause of breaking down the transportation system of the country by the requirements of forage.

Cavalry achievements in this war reached their highest plane in Palestine under Edmund Allenby, an outstanding commander of mobile troops. At Armageddon, Sept. 1918, Allenby faced a strong Turkish army with a superior force of combined arms including three cavalry divisions and bombardment aviation. Crushing the enemy right, he dispatched his cavalry, not against the hostile flank, but against the rear. Fleeing Turkish elements crowded into the ravines and defiles which characterized the terrain. Halted and confused by combat aviation, they were annihilated when struck by the charging cavalry columns. The lesson of Armageddon lay not so much in the prowess of ground mobility as in the example of the formidable power of such forces when supported by fire from the air—a dreadful warning of the devastating type of future war. The transcendent lesson from this war was an exemplification of the need of essential supporting fires for all cavalry action—again, fire power and movement.

Four years of stabilized warfare on the continent of Europe had contributed little to the concept of offensive manoeuvre predicated on fire power and movement. Industrial civilization had furnished new potentialities to the power of weapon fires by development of automatic arms and the co-ordinated concentrative effect of massed artillery. Advancement in automotive vehicles afforded new concepts in factors of time and space. Combat aviation gave new reaches to radii of action and means of fire support. Armoured divisions were developed between World Wars I and II which included all supporting arms needed in modern warfare: infantry, artillery, signal, engineers, etc. These divisions were organized for missions requiring independent action, using great mobility and fire power.

**World War II.**—From the earliest stages of World War II, there emerged military leaders who had developed as an art of war the co-ordinated employment of mass machines on the ground and in the air. The Germans had conceived the effective means of creating fire power from a moving base for the support of highly mobile combat elements through close tactical air support. They produced a fire effect so devastating as to dislocate all hostile defenses and permit freedom of movement for a mobile mass. Under this rain of fire from the air the newer heavy cavalry breached hostile positions by the power of shock. The lighter cavalry, with amazing powers of mobility, rushed forward through the breaches to spread fanlike in devastating attacks upon the nerve and supply centres in the rear. Once in the open the sustained drive of this new cavalry continued under the protective power of their own self-contained fire. Mobility reached great heights. Poland as a first-class power was crushed in the space of days. The highly publicized static defenses of the French Maginot line were passed, and the streamlined power of the German offensive quickly overran western Europe. There were few if any battles of mass tanks on the European continent up to this time but in Africa on the Libyan, with a wide expanse of terrain, a new theory



was developed. Armed forces fought each other with as many as 500 tanks employed on each side. Mobility, surprise and shock were the deciding factors.

In the summer of 1944 the Allied Powers invaded the Normandy coast and launched a successful attack by a team of combined arms with each arm playing its major role. There were infantry, armoured divisions, separate tank battalions, all supported by tactical and strategic air. The operation began with one of the largest air-support missions of the entire war; 2,500 supporting aircraft flew over St. Lô, France, to saturate an area 6,000 yd. wide by 3,000 yd. deep. This was followed by close fighter support over advancing armoured columns. In this operation, the infantry divisions, with separate tank battalions in support, made the initial hole in the German lines and held the shoulders of the penetration, while the armoured divisions, using their speed, shock and mobility, splintered the enemy defenses and drove more than 400 mi. into the rear of the enemy's lines. Six weeks later the Allied armies, stopped by a lack of supplies, were at the German border.

Sixteen U.S. armoured divisions successfully applied the principles of fire movement and shock action to help defeat the axis in World War II. Under Gen. George S. Patton, Jr., many of these units fought their way from Normandy to the Rhine and the Danube, overcoming the last of the famed German panzers in the west. At the same time other elements were pushing up the rugged Italian peninsula and through southeastern France to join their comrades beyond the Alps. With them in this effort were separate mechanized cavalry units which had been designed and equipped primarily for reconnaissance missions, and a large number of separate tank battalions. The reconnaissance units were called upon to perform a great variety of combat missions and spent only a small part of their time on reconnaissance.

It was generally acknowledged after World War II that the tank had become the decisive weapon of the ground force combat team. Military leaders recognized the strategic and tactical importance of armour and its characteristic mobility, massed fire power and terrific shock action.

A U.S. type field army was typical of the emphasis on armour. In each corps there were established three infantry divisions backed up by a mass of armour under the control of the corps commander; namely, an armoured division, an armoured cavalry group and an armoured cavalry regiment (light), with 1,111 tanks in this type field corps. The armoured division is the basic large armoured unit of the combined arms. It comprises a balanced force of essential ground arms and services so organized and equipped as to make it tactically and administratively self-contained and especially suited for missions which require great mobility and fire power. The organization of the armoured division provides great flexibility in the composition of its combat formations.

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**CAVAN, FREDERIC RUDOLPH LAMBART**, 10TH EARL OF (1865–1946), British general, was born Oct. 16, 1865, and succeeded to the title in 1900. Commissioned in the Grenadier Guards 1885, he was A.D.C. to the governor-general of Canada 1891–93; served in the South African War 1901. Retiring from the army in 1913, he was recalled in Aug. 1914 and in Sept. went out to France to take command of the 4th (Guards) Brigade. In June 1915 he was promoted to command of the 50th Division, and in Aug. to the Guards Division. Winning a reputation as a trusted and admired fighting commander, his next step was the command of the IV. Army Corps at Ypres, which he held from Jan. 1916 to March 1918, when he was appointed to succeed General Plumer as commander-in-chief of the British Forces on the Italian front. A notable mark of trust was that the Italian command put him in charge of the X. Italian Army for the final offensive. It was through the initial forcing of the passages of the Piave by the mixed British and Italian troops under his command that the way was paved for the decisive successes which followed. Remaining on the active list after the War, Lord Cavan was appointed to the Aldershot command in 1920 and in 1922 was advanced to be chief of the Imperial General Staff, a unique distinction in that a retired officer was not only brought back to the active list but became the chief of the army. Cautious, perhaps, in his attitude to military progress and new weapons of warfare, he was a tranquilizing influence rather than a driving force. But in view of the political war weariness and military soreness which prevailed during the first stages of rebuilding the regular army, the former quality was an unquestionable aid in paving the way for subsequent reforms. He died in London on Aug. 28, 1946.

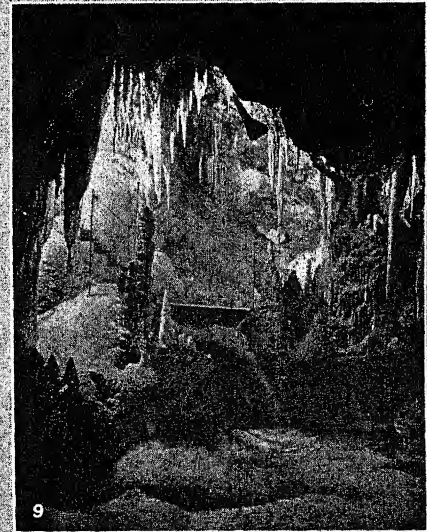
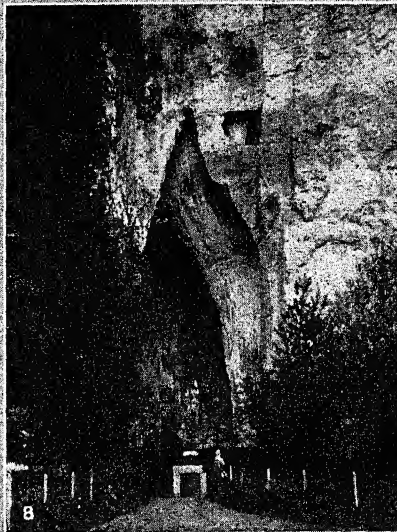
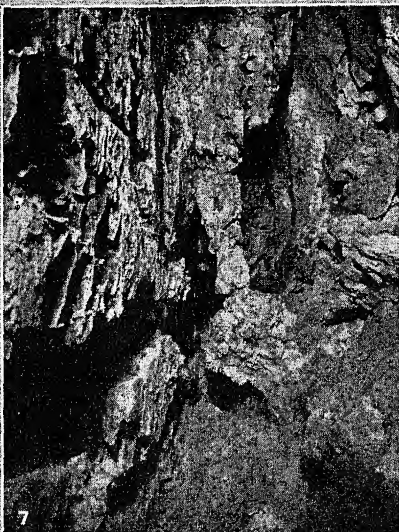
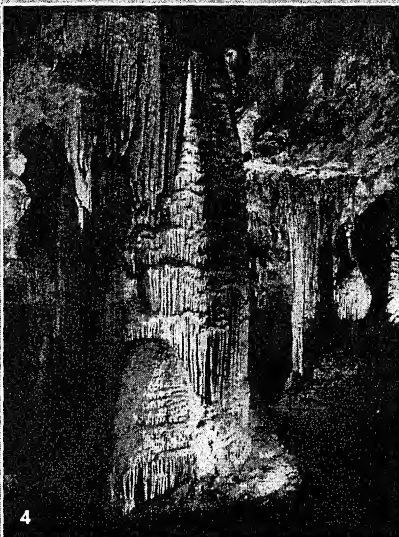
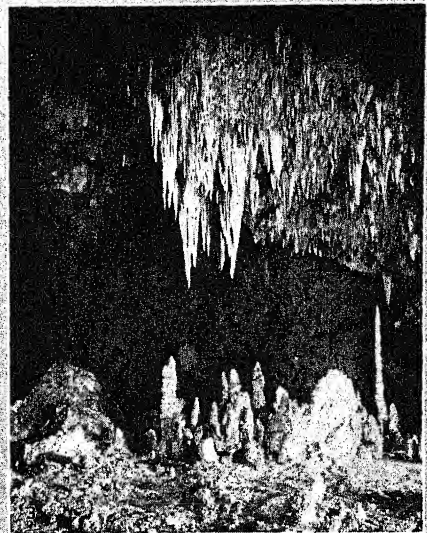
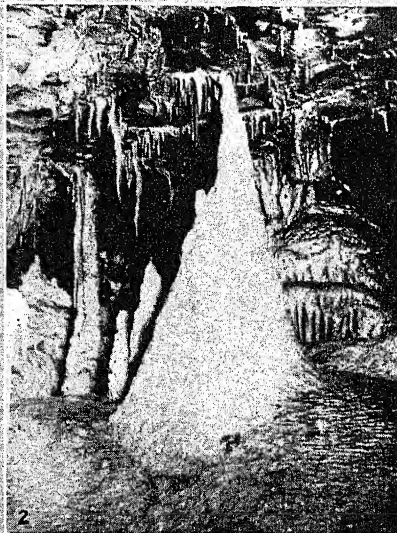
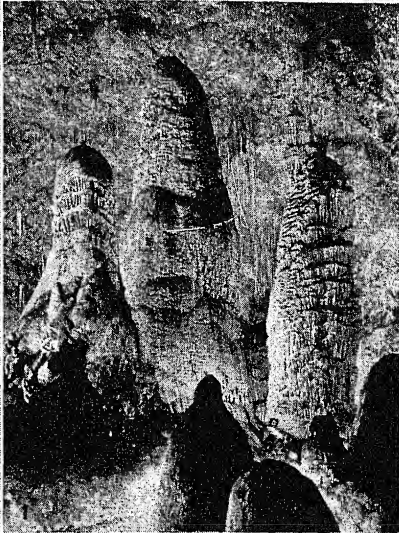
**CAVAN**, a county in the province of Ulster, Ireland, bounded north by Fermanagh and Monaghan, east by Monaghan and Meath, south by Meath, Westmeath and Longford, and west by Longford and Leitrim. Area 730 sq.mi.; pop. (1946) 70,355.

In the north-west is a mountainous district of millstone grit rising in Cuilcagh to a height of 2,188 ft. The source of the Shannon is thought to be near here. The central portion of the county is a low-lying area of carboniferous limestone, covered by numerous lakes, the most important of which is Lough Oughter, and drained chiefly by the river Erne. The land to the south-east is hilly and irregular and here are the underlying Silurian strata that run from Longford to Donaghadee in Co. Down.

For some centuries after the English settlement this district was known as the Brenny, being divided between the families of O'Rourke and O'Reilly; and its inhabitants, protected by the nature of the country, long maintained their independence. In 1579 Cavan was made shire ground as part of Connaught, and in 1584 it was formed into a county of Ulster. The county subsequently came within the scheme for the plantation of Ulster under James I. Some few remains of antiquity exist in the shape of cairns, raths and the ruins of small castles, such as Cloughoughter castle on an island (an ancient crannog) of Lough Oughter. Three miles from the town of Cavan is Kilmore, with its cathedral, a plain erection containing a Romanesque doorway brought from the abbey of Trinity island, Lough Oughter. The bishopric dates from about 1450.

The climate suffers from dampness arising from the numerous lakes. The soil is generally a stiff clay, cold and watery, but capable of much improvement by drainage, for which its undulating surface affords facilities. Only about  $\frac{1}{8}$  of the total area is quite barren. The farms are generally small; oats and potatoes are the principal crops. Flax, once of some importance, is almost neglected. In the higher lands are larger grazing farms which are fairly prosperous.

Cavan is not a manufacturing county. The bleaching of linen and the distillation of whisky are both carried on to a small extent, but the people are chiefly employed in agricultural pursuits and in the sale of home produce. The soil in those districts not well adapted for tillage is peculiarly favourable for trees. The woods were formerly very considerable, and the timber found in the bogs is of large dimensions; but plantations are now chiefly found in extensive demesnes.



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### FAMOUS CAVES THROUGHOUT THE WORLD

1. The Giants' hall. Carlsbad Caverns, national park, New Mexico. Series of connected caverns, probably largest in world
2. Great Onyx cave, near Mammoth cave, Kentucky
3. Carlsbad cave, national monument, New Mexico. The king's throne room
4. Caverns of Luray, Virginia. Leidy column, in the blanket room
5. Shenandoah caverns, Virginia. "The Castle of Cardross"
6. Caverns of Luray, Virginia. Helen's Shawl
7. Black Hills, South Dakota. Wind cave
8. Syracuse, Sicily. The Ear of Dionysius
9. Indian Chamber cave, Jenolan, N.S.W., Australia. The Orient cave





The absence of large urban centres is reflected in the limited railway development. The Great Northern railway from Clones to Cavan and the Great Southern railway from Mullingar in Westmeath to Cavan form a through line from north to south. The Great Northern has branches to Belturbet from Ballyhaise, and to Cootehill from Ballybay; the former is continued westwards by the Great Southern railway which has branches also to Killashandra, and from Navan in Meath to Kingscourt. Cavan returns four members to the Dáil Eireann.

**CAVAN**, urban district and county town of Co. Cavan, Eire, 85½ mi. N.W. of Dublin by the Great Southern railway and the terminus of a branch of the Great Northern of Ireland from Clones. Pop. (1936) 3,393. A Dominican monastery founded by O'Reilly, chieftain of the Brenny, formerly existed here and is the burial place of Owen O'Neill. There was also a castle of the O'Reillys now completely destroyed. The town was burnt in 1690 by the Enniskilleners under Wolseley when they defeated James II.'s troops under the duke of Berwick. There is a grammar school founded by Charles I. and rebuilt on another site in 1819. The town has some linen trade.

**CAVANILLES, ANTONIO JOSÉ** (1745-1804), Spanish botanist, was born in Valencia on Jan. 16, 1745. In 1801 he became director of the botanic gardens at Madrid, where he died on May 4, 1804. In 1785-86 he published *Monadelphiae Classis Dissertationes X.*, and in 1791 he began to issue *Icones et descriptiones plantarum Hispaniae*.

**CAVATINA**, originally a short song of simple character, without a second strain or any repetition of the air. It is now frequently applied to a simple melodious air, as distinguished from a brilliant aria, recitative, etc.

**CAVAZZOLA** or **CAVAZZUOLA, PAOLO MORANDO** (1486-1522), Italian painter of the Veronese school, a pupil of Domenico Morone. He worked at Verona, where he decorated many churches with frescoes (San Nazzaro e Celso, S. Anastasia, S. Chiara, S. Eufemia, S.M. in Organo). His earliest dated work extant was painted in 1508 (Villa Gazzada near Varese). The master is seen at his best in the series of pictures, five in number, which treat of the "Passion," formerly in the church of S. Bernardino and now in the Verona gallery. The series was completed in 1517. Nowhere outside Verona is he so well represented as in the National Gallery, London (which contains two signed pictures, the "St. Roch with the Angel" (1918) and the "Madonna, St. John the Baptist and an Angel." There are also some fine portraits extant (Dresden gallery; Uffizi; Bergamo). The great altarpiece of the Madonna with six saints and with the portrait of the donor, Caterina de Sacchi, is his last work. He died on Aug. 13, 1522, and was buried in St. Polo at Verona. Vasari gives as reason for his premature death that he had set his heart on becoming great, and, working hard, undermined his health. Cavazzola's contemporaries hailed him as the Raphael of the school of Verona.

**CAVE, EDWARD** (1691-1754), English printer, was born at Newton, Warwickshire, on Feb. 27, 1691, and died on Jan. 10, 1754. He entered the grammar school at Rugby, where his father was a cobbler, but was expelled for robbing the master's hen-roost. After many vicissitudes he became apprentice to a London printer and was sent to Norwich to conduct a printing house and publish a weekly paper. While still a printer he obtained a place in the post office, and was promoted to be clerk of the franks. He was at this time engaged in supplying London news-letters to various country papers; and his enemies, who had twice summoned him before the House of Commons for breach of privilege, now accused him of opening letters to obtain his news, and he was dismissed from the service. He then set up a small printing office at St. John's Gate, Clerkenwell, which he carried on under the name of R. Newton. He had long formed a scheme of a magazine "to contain the essays and intelligence which appeared in the two hundred half-sheets which the London press then threw off monthly." In 1731 he put it into execution, and began the *Gentleman's Magazine* (see PERIODICAL), of which he was the editor, under the pseudonym "Sylvanus Urban, Gent." In 1732 he began to issue reports of the debates in both Houses of Parlia-

ment, and in 1738 he was censured for printing the king's answer to an address before it had been announced by the speaker. From that time he called his reports the debates of a "parliament in the empire of Lilliput." To piece together and write out the speeches for this publication was Samuel Johnson's first literary employment. In 1747 Cave was reprimanded for publishing an account of the trial of Lord Lovat, and the reports were discontinued till 1752. Cave published Dr. Johnson's *Rambler*, and his *Irene*, *London and Life of Savage*, and was the subject of a short biography by him.

**CAVE, GEORGE CAVE, 1ST VISCOUNT** (1856-1928), English lord chancellor, was born in London Feb. 23, 1856, and educated at Merchant Taylors' school, London, and St. John's college, Oxford. Called to the bar in 1880, he became K.C. in 1904. In 1906 he entered parliament as Conservative member for Kingston. In 1915 he became solicitor-general and was knighted. On the formation of the first Coalition Government, in 1916, he was appointed home secretary. In 1918 he was appointed a lord of appeal in ordinary, and received a viscountcy. He sat more frequently at the privy council than in the House of Lords, often presiding over the judicial committee of the council, where he showed a great mastery of the intricate points of law, especially of those arising out of Indian appeals. Cave was lord chancellor in Baldwin's first and second Administrations of 1922 and 1924. As lord chancellor he displayed the reasonableness, the dignity and learning which had characterized him throughout his long career. But in his second term of office his health suffered and on March 27, 1928, he resigned. Next day his advance to an earldom was announced, but he died on the following day before the patent had been made out. His widow was created a countess in the May following.

**CAVE, WILLIAM** (1637-1713), English divine, was born at Pickwell, Leicestershire. He was educated at St. John's college, Cambridge, and successively held the livings of Islington (1662), of All-Hallows the Great, Thames street, London (1679), and of Isleworth in Middlesex (1690). Dr. Cave was chaplain to Charles II. and in 1684 became a canon of Windsor. His principal works are the *Apostolici*, or History of Apostles and Fathers in the first three centuries of the Church (1677), and *Scriptorum Ecclesiasticorum Historia Literaria* (1688). The best edition of the latter is the Clarendon Press, 1740-43. He died at Windsor on July 4, 1713.

**CAVE**, a hollow extending beneath the surface of the earth (Lat. *cavea*, from *cavus*, hollow). The word "cavern" (Lat. *caverna*) is a synonym. Caves have been the centres round which have clustered many legends and superstitions, the abode of the sibyls and the nymphs in Roman mythology, in Greek temples, as well as the places where the oracles were delivered.

Caves have been used in all ages by mankind for habitation, refuge and burial. Sanctity attaches to caves in many parts of the world as the abode of powerful spirits, while their use as burial places confers a special importance upon them, since intercourse with the dead, especially those who in life were powerful and eminent in social life, necessarily takes place in proximity to the burial place. Legends like those of Arthur cluster round the caves wherein the hero sleeps his long sleep, whence he shall emerge in due course to a greater glory and a wider empire. We therefore find in them most important testimony as to the ancient history of mankind because they contain evidence of his industry, his mode of life, his ideas and his artistic capacity as well as of the plant and animal world in which he lived (see ARCHAEOLOGY: *Palaeolithic Age*), and animals by which they were formerly inhabited. Caves are frequently considered, among primitive peoples, as the passages to the underworld and as the homes of dead heroes. The names given to caves betray the beliefs of the peoples who name them in the mysterious other-worldliness of these caverns.

**Physical History.**—The most obvious agent in hollowing out caves is the sea. The set of the currents, the force of the breakers, the grinding of the shingle inevitably discover the weak places in the cliff, and leave caves as one of the results of their work, modified in each case by the local conditions of the rock. Those

formed in this manner are easily recognized from their floors being rarely much out of the horizontal; their entrances are all in the same plane, or in a succession of horizontal and parallel planes, if the land has been elevated at successive times. From their inaccessible position they have been rarely occupied by man.

An important class of caves is that composed of those which have been cut out of calcareous rocks by the action of carbonic acid in the rain-water, combined with the mechanical friction of the sand and stones set in motion by the streams which have, at one time or another, flowed through them. They occur at various levels, and are to be met with wherever the strata are sufficiently compact to support a roof.

Caves formed by the action of carbonic acid and the action of water open on the abrupt sides of valleys and ravines at various levels, and are arranged round the main axes of erosion, just as the branches are arranged round the trunk of a tree. The caves themselves ramify in the same irregular fashion as the valleys. Sometimes they are still the passages of subterranean streams; but very frequently the drainage has found an outlet at a lower level, and the ancient watercourses have been deserted. These in every case present unmistakable proof that they have been traversed by water in the sand, gravel and clay which they contain, as well as in the worn surfaces of the sides and bottom. In all districts where there are caves there are funnel-shaped depressions of various sizes called pot-holes or swallow-holes, or bêtôires, "chaldrons du diable," "marmites des géants," or "katavothra," in which the rain is collected before it disappears into the subterranean passages. They are to be seen in all stages, some being mere hollows which only contain water after excessive rain, while others are profound vertical shafts into which the water is continually falling.

America has many caves, some of them picturesquely named by the Indians. For an account of the chief American caves see LURAY CAVERN, MAMMOTH CAVE, WYANDOTTE CAVE, COLOSSAL CAVERN, JACOB'S CAVERN.

**CAVEA**, a term applied both to the ranges of spectators' seats considered as a whole in a Roman amphitheatre (*q.v.*) and also, less commonly, to the cells for wild beasts underneath the arena.

**CAVEAT**, in law, a notice given by the party interested (caveator) to the proper officer of a court of justice to prevent the taking of a certain step without warning. It is entered in connection with dealings in land registered in the land registry, with the grant of marriage licences, to prevent the issuing of a lunacy commission, to stay the probate of a will, letters of administration, etc. Caveat is also a term used in United States patent law (*see* PATENTS).

**CAVEAT EMPTOR**, a Latin phrase meaning literally "Let the buyer beware." It represents a legal rule in the purchase and sale of personal property that the buyer purchases at his own risk in the absence of an express warranty, or unless the law implies a seller's warranty, or there is found to have been fraud in the transaction.

**CAVEDONE, JACOPO** (1577-1660), Italian painter, born at Sassuolo in the Modenese, was educated in the school of the Caracci, and under them painted in the churches of Bologna. His principal works are the "Adoration of the Magi," the "Four Doctors," and the "Last Supper"; and more especially the "Virgin and Child in Glory," with San Petronio and other saints, painted in 1614, and now in the Bolognese academy. Cavedone became an assistant to Guido Reni in Rome. He died at Bologna.

**CAVELL, EDITH LOUISA** (1865-1915), British nurse, was born Dec. 4, 1865, at Swardeston, Norfolk. She entered the London Hospital as a probationer in 1895. In 1907 she was appointed the first matron of the Berkendael Medical Institute, Brussels, which became a Red Cross hospital on the outbreak of the World War. From Nov. 1914 to July 1915 wounded and derelict English and French soldiers were hidden from the Germans by Prince Reginald de Croy at his château near Mons, thence conveyed to the houses of Edith Cavell and others in Brussels, and furnished by them with money, to reach the Dutch frontier, with the aid of guides obtained through Philippe Baucq. On Aug. 5 Edith Cavell was arrested and imprisoned. She ad-

mitted having sheltered and helped to convey to the frontier some 200 English, French and Belgians. A court-martial was held (Oct. 7 and 8) and a Belgian lawyer, M. Sadi Kirschen, defended Edith Cavell. On Oct. 9 Edith Cavell and Philippe Baucq were sentenced to death with three others who were afterwards reprieved. Despite efforts to obtain a reprieve in which Mr. Brand Whitlock, the U.S. Minister at Brussels, was active, Edith Cavell and Philippe Baucq were shot on Oct. 12. Miss Cavell, who had tended many wounded German soldiers with devoted care, faced the firing squad with a dignity which moved the world. To the British chaplain who administered a final sacrament, she made the remark, "patriotism is not enough," which at once became as historic as Nelson's utterance at Trafalgar. On May 15, 1919 her body was removed to Norwich Cathedral, after a memorial service in Westminster Abbey. A memorial statue stands opposite the National Portrait Gallery, London.

See *The Case of Miss Cavell from the Unpublished Documents of the Trial*, interpreted by Ambroise Göt (1920), Sadi Kirschen, *Devant les Conseils de Guerre allemands* (1919); *Correspondence with the United States: Ambassador respecting the Execution of Miss Cavell at Brussels*, Cd. 8013, Stationery Office (1915).

**CAVENDISH, GEORGE** (1500-1562?), the biographer of Cardinal Wolsey, was the elder son of Thomas Cavendish, clerk of the pipe in the Exchequer. About 1527 he entered the service of Cardinal Wolsey as gentleman-usher, and for the next three years he was in the closest personal attendance on the great man. It is plain that he enjoyed Wolsey's closest confidence to the end, for after the cardinal's death George Cavendish was called before the privy council and closely examined as to Wolsey's latest acts and words. Many years passed before his biography was composed. At length, in 1557, he wrote it out in its final form. It was impossible to publish it in the author's lifetime, but it was widely circulated in ms. The book was first printed in 1641, in a garbled text, and under the title of *The Negotiations of Thomas Wolsey*. The genuine text, from contemporary mss., was first published in 1810. Until that time it was believed that the book was the composition of George Cavendish's younger brother William, the founder of Chatsworth, who also was attached to Wolsey; but Joseph Hunter, in a tract called *Who wrote Cavendish's Life of Wolsey?* (1814), proved the claim of George. The book is the sole authentic record of a multitude of events highly important in a particularly interesting section of the history of England. Its biographical excellence was first emphasized by Bishop Creighton, who insisted that Cavendish was the earliest of the great English biographers and an individual writer of particular charm and originality.

See the edition of the *Life* published by S. W. Singer in 1815, which was reprinted, with a biographical introduction, by Henry Morley in the Universal Library Series (1885). See also Francis Bickley, *The Cavendish Family* (1911).

**CAVENDISH, HENRY** (1731-1810), English chemist and physicist, elder son of Lord Charles Cavendish, brother of the 3rd duke of Devonshire, and Lady Anne Grey, daughter of the duke of Kent, was born at Nice on Oct. 10, 1731. He was sent to school at Hackney in 1742, and in 1749 entered Peterhouse, Cambridge, which he left in 1753, without taking a degree. He appears to have spent some time in Paris with his brother Frederick during the following years, and apparently occupied himself in the study of mathematics and physics. Until he was about 40 he seems to have enjoyed a very moderate allowance from his father, but in the latter part of his life he was left a fortune which made him one of the richest men of his time. He lived principally at Clapham Common, but he had also a town house in Bloomsbury, while his library was in a house in Dean street, Soho; and there he used to attend on appointed days to lend the books to men who were properly vouched for. He was a regular attendant at the meetings of the Royal Society, of which he became a fellow in 1760, and he dined every Thursday with the club composed of its members. Otherwise he had little intercourse with society; indeed, his chief object in life seems to have been to avoid the attention of his fellows. With his relatives he had little intercourse, and even Lord George Cavendish, whom he made his principal heir, he saw

only for a few minutes once a year. His dinner was ordered daily by a note placed on the hall table, and his women servants were instructed to keep out of his sight on pain of dismissal. In person he was tall and rather thin; his dress was old-fashioned and singularly uniform, and was inclined to be shabby about the times when the precisely arranged visits of his tailor were due. He had a slight hesitation in his speech, and his air of timidity and reserve was almost ludicrous. He was never married. He died at Clapham on Feb. 24, 1810, leaving funded property worth £700,000, and a landed estate of £8,000 a year, together with canal and other property, and £50,000 at his bankers'. He was buried in the family vault at All Saints' church, Derby; in 1927 this church became the cathedral church of the new diocese of Derby and it was decided to erect a monument there to Henry Cavendish.

Cavendish's scientific work was wide in its range. The papers he himself published form an incomplete record of his researches, for many of the results he obtained only became generally known years after his death; yet the Institute of France in 1803 chose him as one of its eight foreign associates. His first communication to the Royal Society, a chemical paper on "Factitious Airs" (*Phil. Trans.*, 1766), consisted of three parts, a fourth part remaining unpublished until 1839, when it was communicated to the British Association by Canon W. Vernon Harcourt. This paper dealt mostly with "inflammable air" (hydrogen), which he was the first to recognize as a distinct substance, and "fixed air" (carbon dioxide). He determined the specific gravity of these gases with reference to common air, investigated the extent to which they are absorbed by various liquids, and noted that the air produced by fermentation and putrefaction has properties identical with those of fixed air obtained from marble. He introduced new refinements into his experiments, such as the use of drying agents and the correction of the volume of a gas for temperature and pressure. In the following year he published a paper on the analysis of one of the London pump-waters (from Rathbone place, Oxford street), which is closely connected with the memoirs just mentioned, since it shows that the calcareous matter in that water is held in solution by the "fixed air" present and can be precipitated by lime. In 1783 he described observations he had made to determine whether or not the atmosphere is constant in composition; after testing the air on nearly 60 different days in 1781 he could find in the proportion of oxygen no difference of which he could be sure, nor could he detect any sensible variation at different places. Two papers on "Experiments on Air," printed in the *Phil. Trans.* for 1784 and 1785, contain his great discoveries of the compound nature of water and the composition of nitric acid. Starting from an experiment, narrated by Priestley, in which John Warltire fired a mixture of common air and hydrogen by electricity, with the result that there was a diminution of volume and a deposition of moisture, Cavendish burnt about two parts of hydrogen with five of common air and noticed that the only liquefiable product was water. In another experiment he fired, by the electric spark, a mixture of hydrogen and oxygen in a glass globe, similar to the apparatus now called "Cavendish's Eudiometer," and again obtained water. Proceeding with these experiments he found that the resulting water contained nitric acid. In the second of the two papers he gives an account of the methods by which the composition of nitric acid was discovered; he observed also that a very small fraction, about one one-hundred and twentieth, of the "phlogisticated air" of the atmosphere differed from the rest, and in this residue he doubtless had a sample of the inert gas argon which was only recognized as a distinct entity more than 100 years later. It may be noted here that, while Cavendish adhered to the phlogistic doctrine, he did not hold it with anything like the tenacity that characterized Priestley; thus, in his 1784 paper on "Experiments on Air," he remarks that not only the experiments he is describing, but also "most other phenomena of nature seem explicable as well, or nearly as well," upon the Lavoisierian view, but he did not accept it and continued to use the language of the phlogistic theory. Experiments on arsenic, published for the first time in 1921, showed that Cavendish had investigated the properties of arsenic acid about ten years before Scheele.

Cavendish's work on electricity, with the exception of two papers containing relatively unimportant matter, remained in the possession of the Devonshire family until 1879, when the papers were edited by James Clerk Maxwell as the *Electrical Researches of the Hon. Henry Cavendish*. This work shows that Cavendish had anticipated the researches of Coulomb, Faraday and others. He investigated the capacity of condensers and constructed a series of condensers with which he measured the capacity of various pieces of apparatus using the "inch of electricity" as the unit of capacity. He discovered specific inductive capacity and measured this quantity; he showed that electric charges are confined to the surface of a conductor and that the inverse square law of force between charges holds to within 2%. Cavendish introduced the idea of potential under the name of "degree of electrification," in a paper published in 1771, under the title "Attempt to explain some of the principal phenomena of electricity by means of an elastic fluid." He investigated the power of different substances to conduct electrostatic discharges (*Phil. Trans.*, 1775) and completed an enquiry which amounted to an anticipation of Ohm's law.

Cavendish took up the study of heat, and had he published his results promptly he might have anticipated Joseph Black as the discoverer of latent heat and of specific heat. He published a paper on the freezing point of mercury in 1783 and in this paper he expresses doubt of the fluid theory of heat.

Cavendish's last great achievement was his series of experiments to determine the density of the earth (*Phil. Trans.*, 1798). The apparatus he employed was devised by the Rev. John Michell, though he had the most important parts reconstructed to his own designs. (See GRAVITATION.) The figure he gives for the specific gravity of the earth is 5.48, but in fact the mean of the 29 results he records works out at 5.448. Other publications of his later years dealt with the height of an aurora seen in 1784 (*Phil. Trans.*, 1790), the civil year of the Hindus (*Id.* 1792), and an improved method of graduating astronomical instruments (*Id.* 1809). Cavendish also had a taste for geology, and made several tours in England for the purpose of gratifying it.

A life by George Wilson (1818-59), printed for the Cavendish Society in 1851, contains an account of his writings, both published and unpublished, together with a critical enquiry into the claims of all the alleged discoverers of the composition of water. Some of his instruments are preserved in the Royal Institution, London, and his name is commemorated in the Cavendish Physical Laboratory at Cambridge, which was built by the 7th duke of Devonshire.

The remainder of Cavendish's papers were placed at the disposition of the Royal Society by the Duke of Devonshire. In 1921 the previously published work, together with a number of unpublished experiments, appeared under the title: *The Scientific Papers of the Honourable Henry Cavendish, F.R.S.; Vol. I., The Electrical Researches*, revised with preface and notes by Sir J. Larmor. *Vol. II., Chemical and Dynamical*, edited by Sir Edward Thorpe, with additions by Dr. Charles Chree and others.

**CAVENDISH** or **CANDISH, THOMAS** (1552?-1592), the third circumnavigator of the globe, was born in Trimley St. Martin, Suffolk, and educated at Corpus Christi college, Cambridge. In 1585 he accompanied Sir Richard Grenville to America. Soon returning to England, he undertook an elaborate imitation of Drake's great voyage. On July 21, 1586, he sailed from Plymouth with 123 men in three vessels, only one of which (the "Desire," of 140 tons) came home. By way of Sierra Leone, the Cape Verde islands and C. Frio in Brazil, he coasted down to Patagonia (where he discovered "Port Desire," his only important contribution to knowledge), and passing through Magellan's straits fell upon the Spanish settlements and shipping on the west coast of South and Central America and of Mexico. Among his captures was the treasure-galleon, the "Great St. Anne," which he captured off Cape St. Lucas, the southern extremity of California (Nov. 14, 1587). After this success he struck across the Pacific for home; touched at the Ladrones, Philippines, Moluccas and Java; rounded the Cape of Good Hope; and arrived again at Plymouth (Sept. 9-10, 1588), having circumnavigated the globe in two years and 50 days. It is said that his sailors were clothed



in silk, his sails were damask, and his top-mast covered with cloth of gold. Yet by 1591 he was again in difficulties, and planned a fresh American and Pacific venture. John Davis (*q.v.*) accompanied him, but the voyage (undertaken with five vessels) was an utter failure. He died and was buried at sea, on the way home, May 20, 1592.

See Hakluyt's *Principal Navigations*, (a) edition of 1589, p. 809 (NH's narrative of the voyage of 1586-1588); (b) edition of 1599-1600, vol. iii. pp. 803-825 (Francis Pretty's narrative of the same); (c) edition of 1599-1600, vol. iii. pp. 251-253 (on the venture of 1585); (d) edition of 1599-1600, vol. iii. pp. 845-852 (John Lane's narrative of the last voyage, of 1591-1592); also *Stationers' Registers* (Arber), vol. ii. pp. 505-509; the Molyneux Globe of 1592, in the library of the Middle Temple, London, and the Ballads in *Biog. Brit.*, vol. i. p. 1196; E. S. Payne, *Voyages of the Elizabethan Seamen to America* (2 vols., 1893-1900).

**CAVENDISH, SIR WILLIAM** (c. 1505-1557), founder of the English noble house of Cavendish, was the younger brother of George Cavendish (*q.v.*). His father, Thomas, was a descendant of Sir John Cavendish, the judge, who in 1381 was murdered by Jack Straw's insurgent peasants at Bury St. Edmunds. Of William's education nothing seems known, but in 1530 he was appointed one of the commissioners for visiting monasteries; he worked directly under Thomas Cromwell, whom he calls "master," and to whom many of his extant letters are addressed. In 1541 he was auditor of the court of augmentations, in 1546 treasurer of the king's chamber, and was knighted and sworn of the Privy Council. Under Edward VI. and Mary he continued in favour at court; during the latter's reign he partially conformed, but on the occasion of the war with France he with other Derbyshire gentlemen refused the loan of £100 demanded by the queen. He died in 1557. Cavendish acquired large properties from the spoils of the monasteries, but in accordance with the wish of his third wife, Elizabeth, he sold them to purchase land in Derbyshire. This wife was the celebrated "building Bess of Hardwick," daughter of John Hardwicke, of Hardwicke, Derbyshire; she completed the original building of Chatsworth House,—begun in 1553 by her husband,—of which nothing now remains. Her fourth husband was George Talbot, 6th earl of Shrewsbury. By her Cavendish had six children; an elder son who died without issue; William, who in 1618 was created earl of Devonshire; Charles, whose son William became 1st duke of Newcastle; Frances, who married Sir Henry Pierpont, and was the ancestress of the dukes of Kingston; Elizabeth, who married Charles Stuart, earl of Lennox, and was the mother of Arabella Stuart; and Mary, who married Gilbert Talbot, 7th earl of Shrewsbury.

**CAVETTO**, in architecture, any projecting moulding (*q.v.*) with a concave profile of single curvature.

**CAVIARE** or **CAVIAR**, the roe of various species of *Acipenser* or sturgeon prepared, in several qualities, as an article of food. The word is common to most European languages and supposed to be of Turk or Tatar origin, but the Turk word *khavyah* is probably derived from the Ital. *caviata*; the word does not appear in Russian. The best caviare, which can only be made in winter and is difficult to preserve, is the loosely granulated, almost liquid, kind, known in Russia as *ikra*. It is prepared by beating the ovaries and straining through a sieve to clear the eggs of the membranes, fibres and fatty matter; it is then salted with from 4-6% of salt. The difficulty of preparation and of transport has made it a table delicacy in western Europe, where it has been known since the 16th century, as is evidenced by Hamlet's "His play . . . pleased not the million, 'twas caviare to the general."

Caviare is eaten either as an hors d'oeuvre, particularly in Russia and northern Europe, with kummel or other liqueurs, or as a savoury, or as a flavouring to other dishes. The coarser quality, in Russia known as *pajusnaya* (from *pajus*, the adherent skin of the ovaries), is more strongly salted in brine and is pressed into a more solid form than the *ikra*; it is then packed in small barrels or hermetically sealed tins. This forms a staple article of food in Russia and eastern Europe. Though the best forms of caviare are still made in Russia, and the greater quantity of the coarser kinds are exported from Astrakhan, the centre of the trade, larger

amounts are made each year for export in America and also in Germany, Norway and Sweden. The roe of tunny and mullet pickled in brine and vinegar, is used, under the name of "botargo," along the Mediterranean littoral and in the Levant.

**CAVIGLIA, ENRICO** (1862-1945), Italian soldier, was born at Finale Marina (Genoa) on May 4, 1862. After Italy's entry into World War I, he was promoted to major-general and commanded the Bari Brigade. In June 1916 he took over the 29th Division and later was promoted lieutenant-general. In July 1917 he was given command of the XXIV. Corps, which broke through the Austrian lines on the Bainsizza plateau. In June 1918 he was chosen to command the VIII. Army which played an important part in the final victory of Vittorio Veneto. From January to June, 1919, Caviglia was minister of war, and as such became a senator, and in November of the same year he was promoted army general. In Jan. 1920 he took over the command in Venezia Giulia. His task was difficult, since the discipline of the troops had been severely shaken by the example of d'Annunzio's Fiume raid. He restored discipline, and ultimately (Dec. 1920) did not hesitate to use force in driving d'Annunzio from Fiume. In 1926 he was made a marshal. Caviglia died March 22, 1945.

**CAVITE**, a municipality and capital of the province of Cavite, Luzon, Philippine Islands, on a forked tongue of land in Manila bay, 8 mi. S. of Manila. Pop. (1939) 38,254, of whom 19,695 were males and 204 whites. A native town was already in existence there when the Spaniards came and took possession after their occupation of Manila. The Dutch bombarded Cavite in 1647 and it was long a revolutionary centre. In 1872 a military insurrection broke out and in 1896 there was an execution of 13 of the insurgents to whom a monument was erected by their Filipino sympathizers in 1906. The home of Emilio Aguinaldo, the insurrection leader against both Spain and the United States, was the adjoining municipality of Cavite Viejo. On May 1, 1898 Commodore George Dewey of the United States navy commanded a naval force which overcame the Spanish fleet and captured the town. The same reasons which had made it a naval base for the Spaniards led to its continuance as such by the Americans, viz., a good harbour and proximity to Manila. From 1898 until 1941 it was the chief naval base and coaling station of the U.S. fleet in Asiatic waters, the coaling docks being at Sangley point in the north end of the municipality. But on Dec. 7 it was attacked by Japanese forces and was captured and held by them. The surrounding region, of volcanic origin, is fertile and produces Manila hemp, chiefly exported to Japan, rice, sugar, copra, cacao, coffee and corn. There is convenient rail and trolley connection with Manila, as well as a good automobile road. The U.S. navy had established a radio station and arsenal and remains of old fortifications are still visible. Cavite is one of the Tagalog provinces, and one of the four Spanish penitentiaries in the archipelago was there.

**CAVOUR, CAMILLO BENSO, COUNT OF** (1810-1861), Italian statesman, was born at Turin on Aug. 1, 1810. Being a younger son (his brother Gustavo was the eldest) Cavour was destined for the army, and became an engineer officer. He soon developed strongly marked Liberal tendencies and an uncompromising dislike for absolutism and clericalism, which made him a suspect in the eyes of the police and of the reactionaries. After the accession to the throne of Charles Albert, whom he always distrusted, he resigned his commission (1831). During the next few years he devoted himself to the study of political and social problems, to foreign travel, and to acquiring a thorough knowledge of practical agriculture. Cavour's political ideas were greatly influenced by the July revolution of 1830 in France, which proved that an historic monarchy was not incompatible with Liberal principles, and he became more than ever convinced of the benefits of a constitutional monarchy as opposed both to despotism and to republicanism. He applied his knowledge of agriculture to the management of his father's estate at Leri, which he greatly improved, he founded the Piedmontese Agricultural Society, and took the lead in promoting the introduction of steam navigation, railways and factories into the country. Thus his mind gradually evolved, and he began to dream dreams of a united Italy free of

foreign influence. In 1847 the psychological moment seemed to have arrived, for the new pope, Pius IX., showed Liberal tendencies and seemed ready to lead all the forces of Italian patriotism against the Austrian domination. Cavour, although he realized that a really Liberal pope was an impossibility, saw the importance of the movement and the necessity of profiting by it. He founded a newspaper at Turin called *Il Risorgimento*, which advocated the ideas of constitutional reform. In Jan. 1848 the revolution first broke out in Sicily, and Cavour, in a speech before a delegation of journalists, declared that the king must take a decided line and grant his people a constitution. Charles Albert, after much hesitation, was induced to grant a charter of liberties (Feb. 8, 1848). Cavour continued his journalistic activity, and his articles in the *Risorgimento* came to exercise great influence both on the king and on public opinion. When the news of the revolt of the Milanese against the Austrians reached Turin on March 19, Cavour advocated war against Austria. His article in the *Risorgimento* made such an impression that it put an end to the king's vacillations, and a few days after its appearance war was declared (March 25).

During the war elections were held in Piedmont. Cavour was returned in June, and he took his seat in parliament on the right as a Conservative. He was not a good speaker, but he gradually developed a strong argumentative power, and he rose at times to the highest level of an eloquence which was never rhetorical. After the dissolution in Jan. 1849, Cavour was not re-elected. The new parliament had to discuss, in the first instance, the all-important question of whether the campaign should be continued now that the armistice was about to expire. The king decided on a last desperate throw, and recommenced hostilities. On March 23 the Piedmontese were totally defeated at Novara, a disaster which was followed immediately by the abdication of Charles Albert in favour of his son Victor Emmanuel II. The new king was obliged to conclude peace with Austria and the Italian revolution was crushed, but Cavour did not despair. There were fresh elections in July, and this time Cavour was returned. His speech on March 7, 1850, in which he said that, "Piedmont, gathering to itself all the living forces of Italy, would be soon in a position to lead our mother-country to the high destinies to which she is called," struck the first note of encouragement after the dark days of the preceding year. He supported the ministry of which Massimo d'Azeglio was president in its work of reform and restoration, and in October of the same year, on the death of Santa Rosa, he himself was appointed minister of agriculture, industry and commerce. In 1851 he also assumed the portfolio of finance, and devoted himself to the task of reorganizing the Piedmontese finances. By far the ablest man in the cabinet, he soon came to dominate it, but as a result of a quarrel with d'Azeglio he resigned; he made use of his freedom to visit England and France again, in order to sound public opinion on the Italian question. In London he found the leaders of both parties friendly. At this time Sir James Hudson was appointed British minister at Turin, where he became the intimate friend of Cavour and gave him valuable assistance. In Paris, Cavour had a long interview with Prince Louis Napoleon, then president of the republic, and also met several Italian exiles in France.

On Cavour's return he found a new cabinet crisis, and was invited to form a ministry. By Nov. 4, he was prime minister. He devoted the first years of his premiership to developing the economic resources of the country; but in preparing it for greater destinies, he had to meet the heavy expenditure by increased taxation. Cavour's first international difficulty was with Austria; after the abortive rising at Milan in Feb. 1853, the Austrian Government, in addition to other measures of repression, confiscated the estates of those Lombards who had become naturalized Piedmontese, although they had nothing to do with the outbreak. Cavour took a strong line on this question, and on Austria's refusal to withdraw the obnoxious decree, he recalled the Piedmontese minister from Vienna. Then followed the Crimean War, in which Cavour first showed his extraordinary political insight and diplomatic genius. In spite of many difficulties and opposition from both extreme Conservatives and Radicals, he

negotiated Piedmontese participation in the campaign as a means of bringing the Italian question before the Great Powers. General Dabormida, the minister of foreign affairs, disapproved of this policy and resigned. The vacant portfolio was offered to d'Azeglio, who refused it; whereupon Cavour assumed it himself. On the same day (Jan. 10, 1855) the treaty with France and England was signed, and shortly afterwards 15,000 Piedmontese troops under General La Marmora were despatched to the Crimea.

Events at first seemed to justify the fears of Cavour's opponents. Cholera attacked the Piedmontese soldiers, who for a long time had no occasion to distinguish themselves in action; public opinion became despondent and began to blame Cavour, and even he himself lost heart. Then came the news of the battle of the Tchernaya, fought and won by the Italians, which turned sadness and doubt into jubilation. Joy was felt throughout Italy, especially at Milan, where the victory was the first sign of daylight amid the gloom caused by the return of the Austrians. On the summoning of the Congress of Paris at the conclusion of the war, Cavour represented Piedmont. After much discussion, and in spite of the opposition of Austria, who as mediator occupied a predominant position, Cavour obtained that Piedmont should be treated as one of the Great Powers. By his marvellous diplomatic skill, far superior to that of his colleagues, he first succeeded in isolating Austria, secondly in indirectly compromising Napoleon in the Italian question, and thirdly in getting the wretched conditions of Italy discussed by the representatives of the Great Powers. It was now manifest that the liberation of Italy was personified in him. Cavour's chief measure of internal reform during this period was a bill for suppressing all monastic orders unconnected with education, preaching or charity; this aroused strong opposition and led to the minister's resignation. But he was soon recalled, for the country could not do without him, and the bill was passed (May 29, 1855).

Cavour now saw that war with Austria was merely a question of time, and he began to establish connections with the revolutionaries of all parts of Italy. He continued to strengthen Piedmont's military resources, but he well knew that Piedmont could not defeat Austria single-handed. He would have preferred an alliance with Great Britain, who would never demand territorial compensation; but although British sympathies were with Italy, the British Government was keenly anxious to avoid war. From Napoleon more was to be hoped, for the emperor still preserved some of his revolutionary instincts, while the insecurity of his situation at home made him eager to gain popularity by winning military glory abroad; but he still hesitated, and Cavour devoted the whole of his ability to overcoming his doubts. In spite of the Orsini outrage, an "accidental" meeting between Napoleon and Cavour was arranged and took place at Plombières in July, and although no definite treaty was signed the basis of an agreement was laid, whereby France and Piedmont were to declare war against Austria with the object of expelling her from Italy, and a north Italian State was to be formed; in exchange for this help France was to receive Savoy and possibly Nice. A marriage was to be arranged between Prince Jerome Bonaparte and Princess Clothilde, Victor Emmanuel's daughter. But the emperor still hesitated, and Cavour saw that the only way to overcome the many obstacles in his path was to force Austria's hand. Then there was the danger lest an Italy freed by French arms should be overwhelmed under French predominance; for this reason Cavour was determined to secure the co-operation of volunteers from other parts of Italy, and that the war should be accompanied by a series of risings against Austria and the local despots.

The moment war was seen to be imminent, parties of Italians of all classes, especially Lombards, poured into Piedmont to enlist in the army. Cavour also had a secret interview with Garibaldi, with whom he arranged to organize volunteer corps so that the army should be not merely that of Piedmont, but of all Italy. Every day the situation grew more critical, and on Jan. 10, 1859 the king in his speech from the throne pronounced the memorable words "that he could not remain deaf to the cry of pain (*il grido di dolore*) that reached him from all parts of Italy"—words which, although actually suggested by Napoleon, rang

like a trumpet-call throughout the land. In the meanwhile the marriage negotiations were concluded, and during the emperor's visit to Turin a military convention was signed between the two States, and Savoy and Nice were promised to France as a reward for the expulsion of the Austrians from Italy. But Napoleon, ever hesitating, jumped at the Russian proposal to settle the Italian question by means of his own favourite expedient, a congress. To this Austria agreed on condition that Piedmont should disarm and should be excluded from the congress; England supported the scheme, but desired that all the Italian States should be represented. Cavour was in despair at the turn events were taking but decided at last reluctantly to accept the proposal, lest Piedmont should be abandoned by all, while he clung to the hope that Austria would reject it. On April 10, the Austrian emperor, on the advice of the military party, did reject it; and on the 23rd, to Cavour's inexpressible joy, Austria sent an ultimatum demanding the disarmament of Piedmont. Cavour replied that his Government had agreed to the congress proposed by the Powers and that it had nothing more to say. On quitting the chamber that day he said to a friend: "I am leaving the last sitting of the last Piedmontese parliament"—the next would represent united Italy. France now allied herself definitely with Piedmont, and England, delighted at Cavour's acquiescence became wholly friendly to the Italian cause. A few days later Austria declared war.

As La Marmora now took the chief command of the army Cavour added the ministry of war to the others he already held. His activity at this time was astounding, for he was virtually dictator and controlled single-handed nearly all the chief offices of the State. The French and Piedmontese forces defeated the Austrians in several battles, and the people rose in arms at Parma, Modena, Florence and Bologna; the local princes were expelled and provisional governments set up. Cavour sent special commissioners to take charge of the various provinces in Victor Emmanuel's name. But these events, together with Prussia's menacing attitude, began to alarm Napoleon, who, after Solferino, concluded an armistice with Austria at Villafranca on July 8, without previously informing Cavour. When Cavour heard of it he was thunderstruck; he immediately interviewed the king at Monzambano, and in violent, almost disrespectful language implored him not to make peace until Venice was free. But Victor Emmanuel saw that nothing was to be gained by a refusal, and much against his own inclination, signed the peace preliminaries at Villafranca, adding the phrase, "pour ce qui me concerne," which meant that he was not responsible for what the people of other parts of Italy might do (July 12). Lombardy was to be ceded to Piedmont, Venetia to remain Austrian, the deposed princes to be reinstated, and the pope made president of an Italian confederation.

The cabinet resigned the next day, and Cavour privately advised the revolutionists of central Italy to resist the return of the princes, by force if necessary. Palmerston, who had meanwhile succeeded Malmesbury as foreign minister, informed France and Austria that Great Britain would never tolerate their armed intervention in favour of the central Italian despots. On Nov. 10, peace was signed at Zürich, and on the fall of the Rattazzi-La Marmora cabinet the king, in spite of the quarrel at Monzambano, asked Cavour to take office again. Napoleon still refused to consent to the union of Tuscany with Piedmont, but Cavour saw that Napoleon might be ready to deal; although the bargain of the preceding year had not been exactly fulfilled, as the Austrians were still in Venice, he again brought forward the question of Nice and Savoy. On March 24, the treaty was signed, and the emperor's opposition to the annexation of central Italy withdrawn. On April 2, the parliament representing Piedmont, the duchies of Parma and Modena, Tuscany and Romagna, met, and Cavour had the difficult and ungrateful task of explaining the cession of Nice and Savoy. In spite of some opposition, the agreement was ratified by a large majority.

The situation in the kingdom of Naples was now becoming critical, and Cavour had to follow a somewhat double-faced policy, on the one hand negotiating with the Bourbon king (Francis II.), suggesting a division of Italy between him and Victor Emmanuel, and on the other secretly backing up the revolutionary

agitation. Having now learnt that Garibaldi was planning an expedition to Sicily with his volunteers, he decided not to oppose its departure; on May 5, it sailed from Quarto near Genoa. Garibaldi with his immortal Thousand landed at Marsala, and the whole rotten fabric of the Bourbon Government collapsed. He crossed over to the mainland, and entered Naples in triumph. But Cavour feared, that, although Garibaldi himself had always loyally acted in the king of Italy's name, the republicans around him might lead him to commit some imprudence and plunge the country into anarchy, and that Garibaldi might invade the papal States, which would have led to further international complications. But the pope had made considerable armaments; his forces, consisting largely of brigands and foreigners under the French general Lamoricière, maintained a menacing attitude on the frontier; Cavour decided on the momentous step of annexing the papal States with the exception of the Roman province. The Italian forces crossed the frontier from Romagna on Sept. 11, and were everywhere received with open arms by the people; Ancona was taken, Lamoricière was defeated and captured at the battle of Castelfidardo, and on the 20th King Victor marched into the Neapolitan kingdom. On Oct. 1, Garibaldi defeated the Neapolitan troops on the Volturno, and Gaeta alone, where King Francis of Naples had retired, still held out.

Cavour had to use all his tact to restrain Garibaldi from marching on Rome and at the same time not to appear ungrateful. He refused to act despotically, and summoned parliament to vote on the annexation, which it did on the 11th. Two days later Garibaldi magnanimously gave in to the nation's will and handed his conquests over to King Victor as a free gift. Gaeta surrendered on Feb. 13, and King Francis retired to Rome. Parliament was dissolved once more; the new chamber showed an overwhelming majority in favour of Cavour, and Victor Emmanuel was proclaimed king of Italy.

The last question with which Cavour had to deal was that of Rome. In October he declared in parliament that Rome must be the capital of Italy, for no other city was recognized as such by the whole country, and in Jan. 1861 a resolution to that effect was passed. But owing to Napoleon's attitude he had to proceed warily, and made no attempt for the present to carry out the nation's wishes. At the same time he was anxious that the Church should preserve the fullest liberty, and he believed in the principle of "a free Church in a free State." The long strain of these last years had been almost unbearable, and at last began to tell; the negotiations with Garibaldi were particularly trying, for while the great statesman wished to treat the hero and his volunteers generously, he could not permit all the Garibaldian officers to be received into the regular army with the same ranks they held in the volunteer forces. This question, together with that of Nice, led to a painful scene in the chamber between the two men, although they were formally reconciled a few days later. For some time past Cavour had been unwell and irritable, and the scene with Garibaldi undoubtedly hastened his end. A fever set in, and after a short illness he passed away on June 6, 1861. He was buried on his ancestral estate of Santena.

The death of Cavour was a terrible loss to Italy; there remained many problems to be solved in which his genius and personality were urgently needed. But the great work had been carried to such a point that lesser men might now complete the structure. He is undoubtedly the greatest figure of the *Risorgimento*, and although other men and other forces co-operated in the movement, it was Cavour who organized it and skilfully conducted the negotiations necessary to overcome all, apparently insuperable, obstacles.

(L. V.)

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**CAVOUR** (anc. *Caburrum* or *Forum Vibii*), a village of Piedmont, Italy, in the province of Turin, 32 mi. S.W. by rail and steam tram (via Pinerolo) from the town of Turin. Pop. 1,547 (town); 6,244 (commune). It lies on the north side of a huge isolated mass of granite (the Rocca di Cavour) which rises from the plain. On the summit was the Roman village. The town gave its name to the Benso family of Chieri, who were raised to the marquise in 1771, and of which the statesman Cavour was a member.

**CAVY**, the name of several South American rodents of the family Caviidae (see *RODENTIA*); originally it was confined to the domesticated guinea pig and its allies of the genus *Cavia*. (The word "guinea" here may be a corruption of "Guiana" but more probably it means "foreign.") The true cavy is small, self-coloured animals, with short, rounded ears and no tail. They are partly diurnal and live in burrows. The diet is vegetarian and their cries are faint squeaks and grunts. Unlike the prolific guinea pig, which begins to breed at two months old and may be the parent of several hundred individuals in a year, the wild cavy breeds only once a year, producing one or two young at a time. These are born in a very advanced stage of development and begin to feed themselves the following day.

Cavies are widely distributed in South America. The original of the domestic race is *C. cutleri* of Peru. *C. neta* is found at great elevations in the Andes. The restless cavy of Brazil is *C. pamparum*. The Patagonian cavy or mara (*Dolichotis australis*) resembles a hare in shape and habits, but lives in a burrow. Fossil species of this genus, of which there is a second smaller type in Argentina, have been found in Brazil and the Argentine.

**CAWDOR**, village and civil parish, Nairnshire, Scotland. Pop. (1931) 767. The village is situated 5 mi. S.S.W. of Nairn and 3 mi. from Gollanfield Junction on the L.M.S.R. In the vicinity is a large distillery. The castle was the scene, according to the tradition which Shakespeare has perpetuated, of the murder of King Duncan by Macbeth, thane of Cawdor (or Calder), in 1040. Since the oldest part of the structure dates from 1454, however, and seemingly had no predecessor, the tradition has no foundation in fact. The building stands on the rocky bank of Cawdor burn, a right-bank tributary of the Nairn. The massive keep with small turrets is the original portion of the castle, and to it were added, in the 17th century, the modern buildings forming two sides of a square. It is the seat of Earl Cawdor. Kilravock (pronounced *Kilrawk*) castle, 1½ mi. W. of Cawdor, commands the left bank of the Nairn. Its keep dates from 1460, and the later buildings belong to the 17th century. It has been continuously tenanted by the Roses, who settled at Kilravock in 1293, after which date son succeeded father in direct descent. Queen Mary was received at the castle in 1562, and Prince Charles Edward was entertained four days before the battle of Culloden. The gardens are beautiful.

**CAWNPORE**, a city and district of British India in the Allahabad division of the United Provinces. The city is situated on the south bank of the Ganges, 40 m. south-west of Lucknow, and formed from early times a frontier outpost of the people of Oudh and Bengal against their northern neighbours. Clive selected it, on account of its commanding position, as the cantonment for the brigade of troops lent him by the nawab of Oudh. In 1801, when the Ceded Provinces were acquired by the East India Company, it became the chief British frontier station, but by the time of the Mutiny the frontier had left it behind, and it was denuded of troops. It is now again a military station of some importance, and a very large railway centre. But its industrial development has been unique in northern India. Starting with a government harness factory, the manufacture of leather goods in every form has attained the position of a first-class industry. There are also large cotton-mills, a woollen manufactory with a

world-wide reputation and a number of engineering and other minor industries. Extensive city improvements have been launched in order to keep pace with the sanitary requirements of the growing labour force. On the outskirts of the city is a fine agricultural college and demonstration farm. The population of the city and cantonment in 1941 was 487,324.

The name of Cawnpore is indelibly connected with the blackest episode in the history of the Indian Mutiny—the massacre here in July 1857 of hundreds of women and children by the Nana Sahib. The entrenchment, where General Sir H. M. Wheeler with his small band of soldiers and the European and Eurasian residents were exposed for 21 days to the fire of the mutineers, is merely a bare field. About three-quarters of a mile away, on the banks of the river Ganges, is the Massacre Ghat. A grassy road between banks 10 to 12 ft. high leads down to the river, and it was among the trees on these banks that the murderers concealed themselves and shot down the little garrison as soon as they were embarked in the boats which were to take them to safety. On the Ghat itself, or temple steps down to the water, some 600 helpless people were slain, in spite of a promise of safe conduct from the Nana. The remaining 200 victims, who had escaped the bullets of the siege and survived the butchery of the river bank, were massacred afterwards and cast down the famous well of Cawnpore, which is now marked by a memorial and surrounded by gardens. The memorial is crowned by the figure of an angel in white marble, and on the wall of the well itself is the following inscription:

Sacred to the perpetual Memory of a great company of Christian people, chiefly Women and Children, who near this spot were cruelly murdered by the followers of the rebel Nana Dhundu Pant, of Bithur, and cast, the dying with the dead, into the well below, on the xvth day of July, MDCCCLVII.

The DISTRICT OF CAWNPORE is situated between the Ganges and Jumna rivers, and is a portion of the well-watered and fertile tract known as the Doab, the total area being 2,372 sq. mi. The general inclination of the country is from north to south. Besides the two great rivers, the principal streams are the Arand or Rhind, the Kavan or Singar, the Isan and the Pandu. The district is watered by four branches of the Ganges canal. The population in 1941 was 1,556,247.

**CAXTON, WILLIAM** (c. 1422-1491), the first English printer, was born somewhere in the Weald of Kent. The name, which was apparently pronounced Caxton, is identical with Causton, the name of a manor in the parish of Hadlow. The date of Caxton's birth was arbitrarily fixed in 1748 by Oldys as 1412. Blades, however, inferred that in 1438, when he was apprenticed to Robert Large, he would not have been more than 16 years of age. Robert Large was a rich silk mercer who became lord mayor of London in 1439, and the fact of Caxton's apprenticeship to him argues that Caxton's own parents were in a good position. When Large died in 1441, Caxton was probably sent direct to Bruges, then the central foreign market of the Anglo-Flemish trade, for he presently entered business there on his own account. In 1450 his name appears in the Bruges records as standing joint surety for the sum of £100; and in 1463 he was acting governor of the company of Merchant Adventurers in the Low Countries. This association, sometimes known as the "English Nation," was dominated by the Mercers' Company, to the livery of which Caxton had been formally admitted in London in 1453. In 1464 he was appointed to negotiate with Philip, duke of Burgundy, the renewal of a treaty concerning the wool trade, which was about to expire. These attempts failed, but he was again employed in a similar but successful mission in Oct. 1468 to the new duke, Charles the Bold, who had just married Princess Margaret of York, sister of Edward IV. The last mention of Caxton in the capacity of governor of the "English Nation" is on Aug. 13, 1469, and it was probably about that time that he entered the household of the duchess Margaret, possibly in the position of commercial adviser.

He had already begun his translation of the popular mediaeval romance of Troy, *The Recuyell of the Historyes of Troye*, from the French of Raoul le Fèvre; and, after laying it aside for some time, he resumed it at the wish of the duchess Margaret, to whom the ms. was presented. From July 1471 until after Midsummer 1472 Caxton was in Cologne, and it was there, as his disciple

Wynkyn de Worde tells us, that he learned the art of printing. On his return to Bruges, he set up a press, in partnership with Colard Mansion, and there his *Recuyell* was printed in 1474 or 1475. His second book, *The Game and Playe of Chesse*, from the *Liber de ludo scacchorum* of Jacobus de Cessolis through the French of Jehan de Vignay, was finished in 1474, and printed in 1476; the last book printed by Mansion and Caxton at Bruges was the *Quatre derrenieres choses*, an anonymous treatise usually known as *De quattuor novissimis*.

Then Caxton returned to England and established himself, at Michaelmas, 1476, in the almonry at Westminster at the sign of the Red Pale. The first known piece of printing issued from the Caxton press in England is an *Indulgence* printed by Caxton and issued by Abbot Sant on Dec. 13, 1476, which was discovered in the Record Office in 1928 by Mr. S. C. Ratcliffe. The first dated book printed in England was Lord Rivers' translation (revised by Caxton) of *The Dictes and sayenges of the philosophers* (1477) (see BLACK LETTER). The date, Nov. 18, 1477, is given in the colophon to the copy in the John Rylands Library, Manchester, the only one which possesses the colophon. From this time until his death Caxton was busy writing and printing. His services to English literature, apart from his work as a printer (see TYPOGRAPHY), are very considerable. His most important original work is an eighth book added to the *Polychronicon* (vol. viii. in the Rolls Series edition) of Ralph Higden. Caxton revised and printed John of Trevisa's work, and brought down the narrative himself from 1358 to 1460, using as his authorities *Fasciculus temporum*, a popular work in the 15th century, and an unknown *Aureus de universo*. He printed Chaucer's *Canterbury Tales* (1478? and 1483), *Troilus and Creseide* (1483?), the *House of Fame* (1483?), and the translation of Boethius (1478?); Gower's *Confessio Amantis* (1483), and many poems of Lydgate. His press



BY COURTESY OF THE JOHN RYLANDS LIBRARY  
CAXTON'S DEVICE, CONSISTING OF HIS INITIALS AND TRADE MARK, FOUND IN 11 OF HIS 102 BOOKS AND BROADSIDES. IT IS 5½"X4½"

*Eglantine* (1489?), *The Foure Sonnes of Aymon* (1489?); also the *Morale Proverbs* (1478), and the *Fayttes of Armes* and of *Chyualrye* (1489) of Christine de Pisan. The most ambitious production of his press was perhaps his version of the *Golden Legend*, the translation of which he finished in Nov. 1483. It is based on the lives of the saints as given in the 13th century *Legenda aurea* of Jacobus de Voragine, but Caxton chiefly used existing French and English versions for his compilation. The book is illustrated by 70 woodcuts, and Caxton says he was only encouraged to persevere in his laborious and expensive task by the liberality of William, earl of Arundel. The idleness which he so often deprecates in his prefaces was no vice of his, for in addition to his voluminous translations his output as a printer was over 18,000 pages, and he published 96 separate works or editions of works, with apparently little skilled assistance.

The different founts of type used by Caxton are illustrated by Blades and Duff, and there is an excellent selection of Caxtons in the British Museum and in the University library at Cambridge. His books have no title-pages, and from 1487 onwards are usually adorned with a curious device, consisting of the letters W.C. separated by a trade mark, with an elaborate border above and below. The flourishes on the trade mark have been fancifully interpreted as S.C. for Sancta Colonia, implying that Caxton learnt his art at Cologne, and the whole mark has been read as 74, for 1474, the date of his first printed book. This device was subsequently adopted with small alterations by his successor at the Westminster press, Wynkyn de Worde. The first of his books containing woodcut illustrations was his *Myrrour of the World* (1481), translated from Vincent de Beauvais, but he had used a woodcut initial letter in his broadside *Indulgence* printed in 1476.

No record of Caxton's marriage or of the birth of his children has been found, but Gerard Croppe was separated from his wife Elizabeth, daughter of William Caxton, before 1496, when Croppe made certain claims in connection with his father-in-law's will.

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**CAYAPAS**, a tribe of South American Indians, belonging to the Barbacoan (*q.v.*) linguistic stock or sub-stock. Their habitat is the lower Cayapas river and adjacent coasts in northern Ecuador. Traditionally they formerly lived in the upland region about Quito, moving to the coast a short time before the first appearance of Europeans.

They became much mixed with Negroes, and relatively little of their original culture survives.

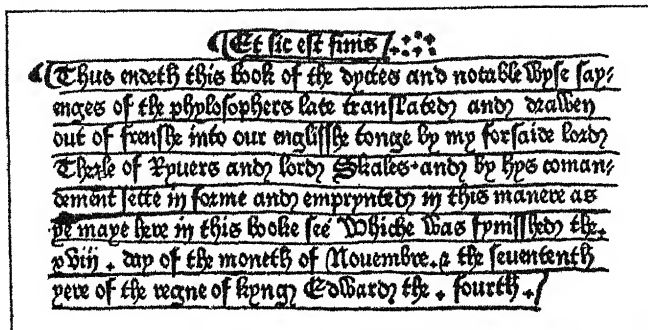
See S. A. Barrett, "The Cayapa Indians of Ecuador" (Museum of the American Indian, *Indian Notes and Monographs*, no. 40. New York, 1925).

**CAYENNE**, capital of French Guiana, is a port standing at the northwestern end of the "isle of Cayenne" formed by the estuaries of the Cayenne and the Mahoury rivers. Its plan is that of a rectangle lying along the sea-front. Its streets, built on a rectangular pattern, are lined by brick or wooden houses of one or two stories. The church of the Holy Saviour and the Jesuits' house are of some antiquity; and there are other interesting buildings, including the Préfecture, around the Place d'Armes. To the west, Mont Cépérou and the Fort Saint-Michel dominate the harbour.

Suitably purified water is available at the rate of 5,000 cu.m. per day. Fever is kept down by draining the marshes and by spraying DDT.

The sea wind mitigates the heat, and the climate, though humid, is healthful. Population (1946) 10,961.

The harbour is liable to be silted up, and there is a bar at the entrance, allowing only 3.80 m. of draught at high tide. There is a metal wharf, but big ships unload at Larivot (a few kilometres distant) or at the Îles du Salut. Once a month a ship goes between Cayenne and Fort de France (Martinique), and aircraft of the New York-Buenos Aires line land four times a week at the aerodrome.



BY COURTESY OF THE JOHN RYLANDS LIBRARY, MANCHESTER  
COLOPHON TO CAXTON'S "DICTES AND SAYENGES OF THE PHYLOSOPHERS" (1477), THE FIRST BOOK PRINTED IN ENGLAND TO BEAR A DATE

The colophon, an inscription placed at the end of a book in early times, contained information now usually found on the title page

was, however, not wanted for purely literary ends, but was a commercial speculation. For the many service-books which he printed there was no doubt a sure sale, and he met the taste of the upper classes and the taste of the lower classes which issued regularly from his press. He printed Malory's *Morte d'Arthur*, and himself translated from the French the *Boke of Histories of Jason* (1477?), *The History of Reynart the Foxe* (from the Dutch, 1481 and 1489?), *Godfrey of Boloigne* or *The Siege and Conquest of Jherusalem* (1481), *The Lyf of Charles the Grete* (1485), *The Knyght Parys and the Fayr Vyenne* (1485), *Blanchardyn and*

An avenue running along the sea-front joins Cayenne to the suburbs of Chaton and Montabo, where are the buildings of the Institut Français d'Amérique Tropicale and the Institut Pasteur. (For history, see GUIANA.) (Hu. DE.)

**CAYENNE PEPPER** (*Guinea Pepper*, *Spanish Pepper*, *Chilly*), a preparation from the dried fruit of various species of *Capsicum*, a genus of the family Solanaceae. The true peppers are members of a totally distinct family, Piperaceae. The fruits of *Capsicum* have a strong, pungent flavour. The capsicums bear a greenish-white flower, with a star-shaped corolla and five anthers standing up in the centre of the flower like a tube, through which projects the slender style. The podlike fruit consists of an envelope at first fleshy and afterwards leathery, within which are the spongy pulp and several seeds. The plants are herbaceous or shrubby; the leaves are entire, and alternate, or in pairs near one another; the flowers are solitary and do not arise in the leaf-axils. There are about 30 species, natives of Central and South America. In the United States chief production is in Louisiana and South Carolina. The output is about 1,000,000 lb. dried. The principal source of cayenne pepper is *C. annuum*, the spur or goat pepper, a dwarf shrub, a native of South America, but commonly cultivated in the East Indies. It produces a small, narrow, bright red pod, having very pungent properties.

*Chillies*, the dried fruit of capsicums, are used to make chilly-vinegar, as well as for pickles. Cayenne pepper is manufactured from the ripe fruits, which are dried, ground, mixed with wheat flour and made into cakes with yeast; the cakes are baked till hard, like biscuit, and then ground and sifted.

Chillies have been in use from time immemorial; they are eaten in great quantity by the people of Guiana and other warm countries and in Europe are consumed both as a spice and as medicine.

**CAYEY**, an interior town of Puerto Rico. Pop. (1950) 18,402, an increase of 227% over 1940. The population of the municipal district in 1950 was 36,634.

The altitude is 1,400 ft.; average temperature about 71° F. Cayey, one of the most healthful towns of the island, is on the military highway built by Spain diagonally across the island from San Juan on the Atlantic ocean to Ponce on the Caribbean sea. One of the branches of this highway extends to Guayama and another to Salinas, both on the Caribbean.

Because of its healthy climate the Spanish rulers established a military post there; the Americans succeeding them used it as a U.S. army post.

The town is the centre of a region where tobacco and coffee of superior quality are produced, and has many warehouses and factories.

**CAYLEY, ARTHUR** (1821–1895), English mathematician, was born at Richmond, Surrey, on Aug. 16, 1821. He entered Trinity college, Cambridge, as a pensioner, became a scholar in May 1840, senior wrangler, first Smith's prizeman and fellow of Trinity in 1842 and a major fellow in 1845. In 1846, he entered at Lincoln's Inn, and became a pupil of the conveyancer Mr. Christie. While practising law he met J. J. Sylvester, and the two spent much time profitably discussing mathematics. He was called to the bar in 1849, and remained at the bar till he was elected to the new Sadlerian chair of pure mathematics at Cambridge in 1863, when he married Susan, daughter of Robert Moline of Greenwich. He held this chair till his death, on Jan. 26, 1895. His 800 mathematical papers, published in 13 large quarto volumes by the Cambridge University press, treat of nearly every subject of pure mathematics, and of theoretical dynamics and spherical and physical astronomy. He was as much a geometer as an analyst. Of special mention are his ten memoirs on quaternions in which he developed the theory of algebraic invariants (1854–78), his creation of the theory of matrices, his researches on the theory of groups, his memoir on abstract geometry, the geometry of *n*-dimensional space, a subject which he created, his introduction to geometry of the "absolute," his researches on the higher singularities of curves and surfaces, the classification of cubic curves, additions to the theories of rational transformation and correspondence, the theory of the twenty-seven lines that lie

on a cubic surface, the theory of elliptic functions, the attraction of ellipsoids, and the British association reports, 1857 and 1862. on recent progress in general and special theoretical dynamics, and on the secular acceleration of the moon's mean motion. Competent judges have compared him with Leonhard Euler for his range, analytical power and introduction of new and fertile theories. He received nearly every academic distinction that can be conferred upon a man of science. His nature was noble and generous, and the universal appreciation of this fact gave him great influence in his university. His recreations were the Victorian classics, water-colour sketching and architecture. His portrait, by Lowes Dickinson, was placed in the hall of Trinity college in 1874, and his bust, by Henry Wiles, in the library of the same college in 1888.

**CAYLUS, ANNE CLAUDE**, COMTE DE, Marquis d'Ester-nay, baron de Bransac (1692–1765), French archaeologist and man of letters, was born in Paris. His mother, the comtesse de Caylus (1673–1729), was a cousin of Mme. de Maintenon, who brought her up like her own daughter. She wrote valuable memoirs of the court of Louis XIV entitled *Souvenirs*; these were edited by Voltaire (1770) and by many later editors, notably by Ch. Asselineau (1860). Caylus was on active service with the French army from 1709–14. After the Peace of Rastadt he travelled in Italy, Greece, the East, England and Germany. He became an active member of the Academy of Painting and Sculpture and of the Academy of Inscriptions. Among his works are *Recueil d'antiquités égyptiennes, étrusques, grecques, romaines et gauloises* (7 vol. 1752–67), *Numismata Aurea Imperatorum Romanorum*, and a *Mémoire* (1755) on the method of encaustic painting with wax mentioned by Pliny, which he claimed to have rediscovered. Caylus was himself an admirable engraver; he also caused engravings to be made of Bartoli's copies from ancient pictures. He encouraged young artists, but his patronage was somewhat capricious. Diderot expressed this fact in an epigram in his *Salon* of 1765: "La mort nous a délivrés du plus cruel des amateurs." The Comte de Caylus had quite another side to his character.

He had a thorough acquaintance with the gayest and most disreputable sides of Parisian life, and left a number of more or less witty stories dealing with it. These were collected (Amsterdam, 1787) as his *Oeuvres badines complètes*. The best of them is the *Histoire de M. Guillaume, cocher* (c. 1730).

**CAYMAN** (or CAIMAN), the name applied to the broad-snouted crocodilians of South America. The black cayman (*Melanosuchus niger*) of the Amazon is a large species, reaching 16 ft. in length. Other smaller species (*Caiman* spp.) are extremely abundant in tropical America. (See CROCODILIAN.) (K. P. S.)

**CAYMAN ISLANDS**, three low-lying islands in the West Indies, Grand Cayman, Little Cayman and Cayman Brac, are between 79° 44' and 81° 27' W. and 19° 15' and 19° 45' N., a dependency of Jamaica, which lies 110–156 mi. E.S.E. Grand Cayman, a flat rock-bound island protected by coral reefs, is approximately 20 mi. long and 8 mi. broad at a maximum. It has two towns, Georgetown and Boddentown. Little Cayman and Cayman Brac are both about 60 mi. N.E. of Grand Cayman. While the soil is shallow and not infertile, commerce is dependent almost exclusively on the various marine industries. The thatch palm *Thrinax argentea* is used for the manufacture of thatch rope for export to Jamaica, but the main industry is the catching of turtles, sharks and sponges. The export of phosphate, coconuts and sisal has ceased. Local mahogany is used to build yachts and schooners.

The government is administered by a commissioner, and the laws passed by the local legislature are subject to the assent of the governor of Jamaica. Pop. (census 1943) 6,670. Land area 93 sq.mi.

The islands were discovered by Columbus, who named them Tortugas, from the turtles with which the surrounding seas abound. They were never occupied by the Spaniards and were colonized from Jamaica by the British.

**CAYUGA AND SENECA CANAL**: see NEW YORK STATE BARGE CANAL SYST. A.



**CAYUSE**, an Indian tribe (of the Wailatpuan linguistic family), that formerly inhabited northeastern Oregon and part of Washington and was noted for its horses and warlike character.

They were closely allied with the Wallawalla and Nez Percés tribes, and there was a great deal of intermarriage, particularly with the latter tribe. The Cayuse signed the treaty of 1855 establishing the Umatilla reservation, where they then lived. The tribe's population was officially given as 404 in 1904, but no Cayuse of pure blood was found on the reservation at the beginning of the 20th century.

Marcus Whitman, who had established a mission near the present city of Walla Walla, Wash., in 1838, his wife and 12 others were massacred in an attack by the Cayuse in 1847. The Indians blamed Whitman, who was a doctor, for the large number of deaths caused by disease. Volunteer troops carried on a prolonged, indecisive campaign against the tribe until five Indians, who confessed to the murders, were voluntarily surrendered in 1850.

In the western states of the United States the term cayuse refers to an Indian pony. In *Three Thousand Miles Through the Rocky Mountains* (1869), A. K. McClure used the word in this sense in his remark that "Twice our kiyuse broke nearly out of the harness. . . . The kiyuse is never perfectly tamed."

**CAYUVAVAN**, a linguistic stock of South American Indians comprising but a single tribe. The validity of this stock is doubtful. The Cayuvavas formerly lived in northern Bolivia on and west of the Mamore river for some 60 mi. above its confluence with the Guaporé. The surviving remnants are now mainly settled at the mission of Exaltacion de Santa Cruz. The Indians of this group were sedentary agriculturists, and known as the best canoe-men of the region. They appear to have retained little of their old culture and, like many of the tribes of this area, are very little known.

See A. D'Orbigny, *L'Homme Américain* (Paris, 1839).

**CAZALÈS, JACQUES ANTOINE MARIE DE** (1758-1805), French orator and politician, was born at Grenade in Languedoc, of a family of the lower nobility. Before 1789 he was a cavalry officer, but in that year was returned as deputy to the states general. In the Constituent Assembly he belonged to the section of moderate royalists who sought to set up a constitution on the English model, and his speeches in favour of retaining the right of war and peace in the king's hands and on the organization of the judiciary gained the applause even of his opponents. After the insurrection of Aug. 10, 1792, which led to the downfall of royalty, Cazalès emigrated. He fought in the army of the émigrés against revolutionary France, lived in Switzerland and in England, and did not return to France until 1803. He died on Nov. 24, 1805. His son, Edmond de Cazalès, wrote philosophical and religious studies.

See *Discours de Cazalès*, ed. by Chare (1821), with an introduction; F. A. Aulard, *Les Orateurs de la Constituante* (2nd ed., 1905).

**CAZALIS, HENRI** (1840-1909), French poet and man of letters, was born at Cormeilles-en-Parisis (Seine-et-Oise). He wrote under the pseudonyms of Jean Caselli and Jean Lahor. His oriental habits of thought earned for him the title of the "Hindou du Parnasse contemporain."

His works include: *Chants populaires de l'Italie* (1865); *Vita tristis, Réveries fantastiques, Romances sans musique* (1865); *Le Livre du néant* (1872); *Henry Regnault, sa vie et son oeuvre* (1872); *L'Illusion* (1875-93); *Melancholia* (1878); *Cantique des cantiques* (1885); *Les Quatrains d'Al-Gazali* (1896); *William Morris* (1897). See P. Bourget in *Anthologie des poètes fr. du XIX.<sup>e</sup> siècle* (1887-88); J. Lemaitre, *Les Contemporains* (1889); E. Faguet in *Revue bleue* (Oct. 1893).

**CAZEMBE**, the name of an African kingdom which was situated south of Lake Mweru and north of Lake Bangweulu, between 9° and 11° S. In 1894 it was divided between Northern Rhodesia and Belgian Congo. The Cazembe kingdom was named after Muata Cazembe, the hereditary name of its ruler. It was founded by the Baluba, who formed a powerful state in the Kasai region. Muata Yamvo, the Baluba ruler, desiring to control the salt deposits of the Bangweulu, conquered the area early in the 17th century. Baluba formed the aristocracy of the conquered country, and a Baluba was appointed ruler with the title Muata Cazembe. Although autonomous in its political affairs, Cazembe

remained nominally dependent on the Baluba state until 1875. Economically, the country was well developed on account of its ivory trade monopoly with Arabs and Portuguese on the east coast. Also, the copper mines of Katanga, which supplied Central and East Africa, were an important source of wealth for the country. (Under European control the Katanga copper mines developed into large industries which in 1939 supplied 25% of the world's production.) About 1875 the Baluba dynasty was overthrown by Msiri, an east African adventurer of the Nyamwezi tribe, who, equipped with European rifles, conquered Cazembe and the adjacent areas. After Msiri's accidental death while negotiating with a Belgian, Captain Bodson, the kingdom disintegrated rapidly. Cazembe was first visited in 1796 by Manoel Caetano Pereira, a Portuguese merchant; Dr. Francesco José Maria de Lacerda explored the kingdom in 1831 and David Livingstone in 1868. The last vestige of the kingdom is the village of Kazembe (9° 48' S., 28° 51' E.) in Northern Rhodesia.

See Brohez, "Ethnographie Katangaise," *Bulletin, Société Belge de Géographie* (1909); R. F. Burton, *The Lands of the Cazembe* (1873) (H. A. Wf)

**CAZIN, JEAN CHARLES** (1841-1901), French landscape painter, son of a well-known doctor, F. J. Cazin (1788-1864), was born at Samer, Pas-de-Calais. After studying in France, he went to England and was strongly influenced by the pre-Raphaelite movement. His chief earlier pictures have a religious interest; such are "The Flight into Egypt" (1877) and "Hagar and Ishmael" (1880, Luxembourg). Later, his combination of luminous landscape with figure-subjects ("Souvenir de fête," 1881; "Journée faite," 1888) gave him a wide repute and made him the leader of a new school of idealistic subject-painting in France. His wife, Marie Cazin, who was his pupil, was also a well-known artist and sculptor.

**CAZOTTE, JACQUES** (1719-1792), French author, was born at Dijon. He was educated by the Jesuits, and at 27 obtained a public office at Martinique, returning to Paris in 1760 with the rank of commissioner-general. The most famous of his works is the *Diable amoureux* (1772), a tale with a Spanish setting in which the hero raises the devil. About 1775 Cazotte embraced the views of the Illuminati, declaring himself possessed of the power of prophecy. It was upon this fact that La Harpe based his famous *jeu d'esprit*, in which he represents Cazotte as prophesying the most minute events of the Revolution. On the discovery of some fantastic letters in Aug. 1792, Cazotte was arrested; and though he escaped for a time through the heroism of his daughter he was executed on Sept. 25.

Other works by Cazotte are *Les Mille et une fadaïses* (1742; Eng. trans. 1927); and a prose epic *Ollivier* (1762). The only complete edition is the *Oeuvres badines et morales, historiques et philosophiques de Jacques Cazotte* (1816-17), though more than one collection appeared during his lifetime. An edition de luxe of the *Diable amoureux* was edited (1878) by A. J. Pons, and a selection of Cazotte's *Contes*, edited (1880) by Octave Uzanne, is included in the series of *Petits Conteurs du XVIII<sup>e</sup> siècle*. The best notice of Cazotte is in the *Illuminés* (1852) of Gérard de Nerval.

**CAZUNGO**: see ANGOLA.

**"C" BATTERY** is an electric battery, used in radio circuits. It is connected between the cathode or negative electrode and the grid of a vacuum tube and supplies a direct voltage to the grid.

**CEANOTHUS**, a showy genus of North American shrubs and woody vines of the buckthorn family (Rhamnaceae), comprising more than 50 species found chiefly in the Pacific coast region, 30 of which are native to California. The small white or blue flowers are borne in handsome dense panicles or umbels. Several are grown as garden plants. Only two species occur east of the Rocky mountains—the New Jersey tea (*C. americanus*), so called because its leaves were used as tea during the American Revolution, and *C. ovatus*. The genus attains its maximum development in the foothills and mountains of California, often constituting a considerable part of the chaparral. Noteworthy representatives are the California lilac and the Oregon tea-tree (*q.v.*).

See M. Van Rensselaer and H. E. McMinn, *Ceanothus*, xii, 1-308, illus. (1942).

**CEARÁ**, a northern maritime State of Brazil, bounded north by the Atlantic, east by the Atlantic and the States of Rio Grande

do Norte and Paraíba, south by Pernambuco, and west by Piauí, and having an area of 57,371 sq miles. It lies partly upon the northeast slope of the great Brazilian plateau, and partly upon the sandy coastal plain. Its surface is a succession of great terraces, facing north and northeast, formed by the denudation of the ancient sandstone plateau which once covered this part of the continent; the terraces are seamed by watercourses, and their valleys broken by hills and ranges of highlands, usually described as mountain ranges, but in fact only the remains of the ancient plateau, capped with horizontal strata of sandstone and having a remarkably uniform altitude of 2,000 to 2,400 ft. The flat top of such a range is called a *chapada* or *taboleiro*, and its width in places is from 32 to 56 mi.

The boundary line with Piauí follows one of these ranges, the Serra Ibiapaba, which unites with another range on the southern boundary of the state known as the Serra do Araripe. Another range, or escarpment, crosses the state from east to west, but is broken into two principal divisions, each having several local names. These ranges are not continuous, the breaking down of the ancient plateau having been irregular and uneven. The higher ranges intercept considerable moisture from the southeast trade winds, and their flanks and valleys are covered with forest, but the plateaus are either thinly wooded or open campo. These upland forests are of a scrubby character and are called *caatingas*.

The sandy, coastal plain, with a width of 12 to 18 mi., is nearly bare of vegetation; behind there is a more elevated region with broken surfaces and sandy soil which is amenable to cultivation and produces fruit, cotton and most tropical products when conditions are favourable. The rivers of the state are small and, with one or two exceptions, become completely dry in the dry season. The largest is the Jaguaribe, which flows entirely across the state in a northeast direction with an estimated length of 210 to 465 mi. The year is divided into a rainy and dry season, the rains generally beginning in October and lasting until December. The soil of the interior is thin and porous and does not retain moisture; consequently the long, dry season turns this part of the country into a barren waste, relieved only by vegetation along the river courses and mountain ranges and by the hardy, widely distributed carnauba palm (*Copernicia cerifera*), which in places forms groves of considerable extent. Sometimes the rains fail altogether, and then a drought (*sêca*) ensues, causing famine and pestilence throughout the entire region. The most destructive droughts recorded were those of 1711, 1723, 1777-78, 1790, 1825, 1844-45 and 1877-79, the last-mentioned destroying nearly all the livestock in the state and causing through starvation and pestilence the deaths of nearly 500,000 persons—more than half the population—while thousands more were obliged to emigrate to other states.

There are two lines of railway running inland from the coast: the Baturité line from Fortaleza to Crato, in the southern part of the state, and to Patos in the state of Paraíba; and the Sobral line from Camocim to Crateús, about 210 mi. The railways were built by the national government after the drought of 1877-79 to give work to the starving refugees. Great dams are also being constructed and extensive irrigation systems laid out.

Only a very small percentage of the population, which numbered 2,735,702 (1950 census), is of European origin, the large majority being mestizos. There are few Negroes.

The state of Ceará became a bishopric of the Roman Catholic Church in 1853, the bishop having his residence at Fortaleza. The state is represented in the national congress by 3 senators and 17 deputies. The capital, Fortaleza, sometimes called Ceará, is the principal commercial centre and shipping port. Its population was 213,604 and that of the *município* was 280,084 in 1950. The principal towns are Aracati, Baturité, Acaraú, Crato, Maranguape and Sobral.

The territory of Ceará included three of the *capitanias* originally granted by the Portuguese crown in 1534. The first attempts to settle the territory failed, and the earliest Portuguese settlement was made near the mouth of the Rio Camocim in 1604. The French were already established on the coast, with their headquarters at St. Louis, now Maranhão. Ceará was occupied by the Dutch from 1637 to 1654, and became a dependency of Per-

nambuco in 1680; this relationship lasted until 1799, when the *capitania* of Ceará was made independent. The *capitania* became a province in 1822 under Dom Pedro I. A revolution followed in 1824, the president of the province was deposed 15 days after his arrival, and a republic was proclaimed. Internal dissensions broke out, the new president was assassinated, and after a brief reign of terror the province resumed its allegiance to the empire. Ceará was one of the first provinces of Brazil to abolish slavery.

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**CEAWLIN** (d. 593), king of the West Saxons, included, in the *Anglo-Saxon Chronicle*, among the "Bretwaldas" or specially powerful kings, succeeded his father Cynric in 560. He took Silchester, and moving eastward Ceawlin and his brother Cutha defeated the forces of Aethelberht, king of Kent, at the battle of Wihbandun in 568. In 577 he led the West Saxons from Winchester towards the Severn valley; gained a victory over three British kings, Conmail, Condidan and Farinmail, at Deorham and added the district round Gloucester, Bath and Cirencester to his kingdom, thus isolating the Britons of Cornwall from those of Wales. A further advance was begun in 583. Uriconium, a town near the Wrekin, and Pengwyn, the modern Shrewsbury, were destroyed, but Ceawlin was defeated by the Britons at Fethanleag or Faddile, near Nantwich, and his progress was effectually checked. Internal strife among the West Saxons followed. In 591 Ceawlin lost the western part of his kingdom; in 592 he was defeated by his nephew, Ceolric, at Wanborough, driven from Wessex and was killed in 593.

See *Two of the Saxon Chronicles*, ed. by C. Plummer (Oxford, 1892); E. Guest, *Origines Celticae*, vol. ii (1883).

**CEBES**, the name of two Greek philosophers. (1) CEBES OF CYZICUS, mentioned in Athenaeus (iv, 156 D), seems to have been a Stoic, who lived during the reign of Marcus Aurelius. Some would attribute to him the *Tabula Cebetis* (see below), but as that work was well known in the time of Lucian, it is probably to be placed earlier. (2) CEBES OF THEBES, a disciple of Socrates and Philolaus. He is one of the speakers in the *Phaedo* of Plato, in which he is represented as an earnest seeker after virtue and truth, keen in argument and cautious in decision. Three dialogues, the *Ἐβδόμη*, the *Φθινυχος* and the *Πίναξ* or *Tabula*, are ascribed to him by Suidas and Diogenes Laërtius. The two former are lost, and most scholars deny the authenticity of the *Tabula* on the ground of material and verbal anachronisms. They attribute it either to Cebes of Cyzicus (above) or to an anonymous author, of the 1st century A.D., who assumed the character of Cebes of Thebes. In the form of an interpretation of an allegorical picture in the temple of Cronus at Athens or Thebes, it develops the Platonic theory of pre-existence, and shows that true education consists in the formation of character.

The *Tabula* has been translated both into European languages and into Arabic (the latter published with the Greek text and Lat. trans. by Salmasius in 1640); Eng. trans. by H. E. Seebohm (Chipping Camden, 1906). It is usually printed together with Epictetus. Separate eds. by S. S. Jerram (with intro. and notes, 1878), C. Prächter (1893) and many others. See Zeller's *History of Greek Philosophy*; F. Klopfer, *De Cebetis Tabula* (1818-22); C. Prächter, *Cebetis Tabula quam aetate conscripta esse videatur* (1885); R. T. Clark, *Characters of Theophrastus*, etc. (1909).

**CEBU** (Bisayan Sugbu), the second of the 21 chartered Philippine cities in rank of population, 167,411 in 1948 (an increase of 101,909 since 1918) is in the island province of Cebu, of which it is the capital and is on the east coast.

Cebu is one of the most historic points in the Philippines. A native village had long existed on the site of the present city when Magellan, commander of the first world encircling expedition, landed there on April 7, 1521. Opposite the site lies

Mactan Island (whose northwest shore forms the harbour's outer rim) where he met the native chief, Sicutuan, where each sealed a truce compact with his own blood and where, despite the compact, the great navigator lost his life. The image of Santo Niño (the Holy Child), now housed in the Augustinian church, is said to date from that period. The next distinguished foreign visitor was Miguel López de Legazpi, who arrived with some Augustinian friars, including Urdaneta, in 1565; and for the ensuing six years Cebu was the capital of whatever portion of the Philippines the Spaniards ruled. That distinction ceased with Legazpi's removal to what is now Manila; but Cebu has continued to be an important centre for the Bisayas, rivalled by Iloilo alone, which the former has now far outstripped. Toward the end of the 18th century the Roman Catholic cathedral was completed. Cebuanos took a prominent part in the insurrections against both Spain and the United States; but Cebu has profited immensely by the American occupation and its wide streets, motor roads, modern buildings and public school system are but a few of the results.

Cebu was open to foreign trade in 1863. It had long been a port of entry and its harbour is amply protected from the typhoons and baguios to which the region is subject. The city is also the principal one on the railway which skirts the province's eastern coast. An extensive maritime trade is carried on with Manila and Leyte, Bohol and the Negros provinces, Mindanao and elsewhere. The chief exports are abaca (Manila hemp), tobacco, sugar and copra. Manufactures of pottery, fabrics, sugar sacks and salt are carried on.

Cebu is a Roman Catholic Episcopal see and 137,555 of its adherents were reported from there in 1939. The bishop's palace, though small, is noted for its interior decorations. There were also reported from Cebu 2,971 members of the Independent Filipino Church, 2,139 Protestants, 1,262 Buddhists and several thousand of other, or no religious affiliation. Cebuano, the local Bisayan, is the vernacular. There is a provincial high school together with grade and parochial schools, a branch of the Philippine library and a meteorological station.

**CECCO D'ASCOLI** (1257-1327), the popular name of FRANCESCO DEGLI STABILI, a famous Italian encyclopaedist and poet—Cecco being the diminutive of Francesco, and Ascoli, in the marshes of Ancona, the place of his birth. In 1322 he was made professor of astrology at Bologna university, but, having written a commentary on the sphere of John de Sacrobosco (pub. Venice, 1518), in which he propounded daring theories concerning the agency of demons, he got into difficulties with the clerical party. He betook himself to Florence, where his attack on the *Commedia* of Dante, and the *Canzone d'Amore* of Guido Cavalcanti sealed his fate. He was burned at Florence in 1327.

His *Acerba* (from *acervus*), an encyclopaedic poem (best ed. Venice, 1510), consists of four books in *sesta rima*, treating in order of astronomy and meteorology, of stellar influences, of physiognomy, of the vices and virtues of minerals, of the love of animals, of moral, physical and theological problems.

See G. Castelli, *La Vita e le Opere di C. d'Ascoli* (Bologna, 1892), and C. Lozzi, *C. d'Ascoli* (1904).

**CECIL**, the name of a famous English family. This house, whose two branches hold each a marquessate, had a great statesman and administrator to establish and enrich it. The first Lord Burghley's many inquiries concerning the origin of his family created for it more than one splendid and improbable genealogy, although his grandfather is the first ascertained ancestor. In the latter half of the 15th century a family of yeomen or small gentry with the surname of Seyceld, whose descendants were accepted by Lord Burghley as his kinsmen, lived on their lands at Allt yr Ynys in Walterstone, a Herefordshire parish on the Welsh marches. Of the will of Richard ap Philip Seyceld of Allt yr Ynys, made in 1508, one David ap Richard Seyceld, apparently his younger son, was overseer. This David seems identical with David Cyswell, Scisseld or Cecill, a yeoman admitted in 1494 to the freedom of Stamford in Lincolnshire. At Stamford he prospered, being three times mayor and three times member of parliament for the borough, and he served as sheriff of Northamptonshire in 1532-33. Remaining in the service of Henry VIII. he was advanced to be yeoman of the chamber and sergeant-at-arms, being rewarded with several profitable leases and offices. By his first marriage David Cecil left at his death in 1536 a son and heir, Richard Cecil, who enjoyed a place at court as yeoman of the king's wardrobe under Henry VIII. and Edward VI. A gentleman of the privy chamber and sometime sheriff of Rutland, Richard Cecil had his share at the distribution of abbey lands, St.

Michael's priory in Stamford being among the grants made to him. William Cecil, only son of Richard, was born, by his own account, in 1520, at Bourne in Lincolnshire. He advanced himself first in the service of the protector Somerset, after whose fall, his great abilities being necessary to the council, he was made a secretary of state and sworn of the privy council. In 1571 he was created Lord Burghley, and from 1572, when he was given the Garter, he was lord high treasurer and principal minister to Queen Elizabeth. By his first wife, Mary Cheke, sister of the scholar Sir John Cheke, tutor to Edward VI., he was father to Thomas, first earl of Exeter. By a second wife, Mildred Cooke, the most learned lady of her time, he had an only surviving son, Robert Cecil, ancestor of the house of Salisbury.

Created earl of Exeter by James I., the second Lord Burghley was more soldier than statesman, and from his death to the present day the elder line of the Cecils has taken small part in public affairs. William Cecil, 2nd earl of Exeter, took as his first wife the Lady Roos, daughter and heir of the 3rd earl of Rutland of the Manners family. The son of this marriage inherited the barony of Roos as heir general, and died as a Roman Catholic at Naples in 1618 leaving no issue. A third son of the 1st earl was Edward Cecil, a somewhat incompetent military commander, created in 1625 Lord Cecil of Putney and Viscount Wimbledon, titles that died with him in 1638, although he was thrice married. In 1801 a marquessate was given to the 10th earl of Exeter, the story of whose marriage with Sarah Hoggins, daughter of a Shropshire husbandman, has been refined by Tennyson into the romance of "The Lord of Burleigh." This elder line is still seated at Burghley, the great mansion built by their ancestor, the first lord.

The younger or Hatfield line was founded by Robert Cecil, the only surviving son of the great Burghley's second marriage. As a secretary of State he followed in his father's steps, and on the death of Elizabeth he may be said to have secured the accession of King James, who created him Lord Cecil of Essendine (1603), Viscount Cranborne (1604), and earl of Salisbury (1605). Forced by the king to exchange his house of Theobalds for Hatfield, he died in 1612, worn out with incessant labour, before he could inhabit the house which he built upon his new Hertfordshire estate. Of Burghley and his son Salisbury, "great ministers of state in the eyes of Christendom," Clarendon writes that "their wisdom and virtues died with them." The 2nd earl of Salisbury, "a man of no words, except in hunting and hawking," was at first remarked for his obsequiousness to the court party, but taking no part in the Civil War came at last to sit in the Protector's parliament. After the Restoration, Pepys saw him, old and discredited, at Hatfield, and notes him as "my simple Lord Salisbury." The 7th earl was created marquess of Salisbury in 1789.

Hatfield House, a great Jacobean mansion which has suffered much from restoration and rebuilding, contains in its library the famous series of state papers which passed through the hands of Burghley and his son Salisbury, invaluable sources for the history of their period. (O. B.)

(See also, EXETER, EARL, MARQUESS AND DUKE OF; members of the Cecil family separately mentioned are: BURGHLEY, WILLIAM CECIL; SALISBURY, ROBERT ARTHUR TALBOT GASCOGNE-CECIL, 3RD MARQUESS OF; SALISBURY, ROBERT CECIL, 1ST EARL OF; CECIL, HUGH RICHARD; CECIL OF CHELWOOD, 1ST VISCOUNT).

**CECIL, HUGH RICHARD** (BARON QUICKSWOOD) (1869- ), English politician, youngest son of the 3rd Marquess of Salisbury, the prime minister, was born on Oct. 14, 1869, and was educated at Eton and University college, Oxford, where he obtained a first class in modern history in 1891, and was elected a fellow of Hertford college. He became one of his father's secretaries. He sat in the House of Commons as a Unionist for Greenwich (1895-1906), and for Oxford university from 1910 onward. He took a keen interest in church matters and was remarkable in debate for his oratorical powers and the loftiness of his ideals. In the stormy debates on the Balfour Education bill of 1902 he maintained that the only possible basis of general agreement was that every child should be brought up in the belief of its parents. He and Winston Churchill gathered round them, in the early years of the 20th century, a small group of young and able Con-



servative members, whose independent proceedings attracted some attention. He took a decided part in resisting tariff reform, and had no seat in the House between 1906 and 1910. He threw himself immediately and with passion into the struggle over the proposed curtailment of the powers of the House of Lords, and was active in resistance to the Parliament bill.

During the World War he joined the Flying Corps; he also served as a member of the commission that enquired into the Mesopotamia expedition. After the war he took a less active part in politics, but generally found himself in agreement with his brother, Lord Robert (later Lord Cecil of Chelwood), in adopting a more independent attitude toward the Coalition Government. With him, too, he supported the Enabling bill, and he became a prominent member of the Church Assembly set up in accordance with its provisions. In the conflict which arose over the Prayer Book Measure in 1928 he gave energetic support to the new proposals, both inside and out of the House of Commons. In 1936 he was appointed Provost of Eton, and resigned from parliament. He was created baron in 1941.

**CECIL OF CHELWOOD, EDGAR ALGERNON ROBERT CECIL**, 1ST VISCOUNT (1864– ), British statesman, known before his elevation to the peerage as Lord Robert Cecil, third son of the third Marquess of Salisbury, was born on Sept. 14, 1864. He was educated at Eton and University college, Oxford, and was a prominent speaker at the Oxford Union. Lord Robert acted as one of his father's private secretaries from 1886 to 1888. He was called to the bar at the Inner Temple in 1887, and appeared in many important cases. He took silk in 1900.

In 1906 he entered parliament as Conservative member for East Marylebone, and he was one of the principal critics of Birrell's abortive education bill of that year. On many questions he took a heterodox position from the party point of view. In particular he dissociated himself from the tariff reform policy of Chamberlain, and thereby with Parliament from 1910 to 1911, when he was returned at a by-election for the Hitchin division of Herts, retaining this seat until his elevation to the peerage in 1923. He immediately resumed his old place as a powerful, though independent critic of Liberal policy, especially of the disestablishment of the church in Wales. He was one of the best friends of the women suffragists, and expressed the strongest disapprobation of the violent measures taken against them, though he did not palliate the offences against law and order of the extreme militants. Ultimately, after women had been granted the suffrage, he had the satisfaction of carrying a resolution "to amend the law with respect to the capacity of women to sit in Parliament" (Oct. 21, 1918).

Lord Robert was in office throughout the World War from the time that the Unionists associated themselves with the Government in May 1915 till the Armistice. As under-secretary for foreign affairs, then as minister of blockade and lastly as assistant secretary of State for foreign affairs, he was mainly concerned with the vital question of blockade. Lord Robert resigned at the general election of 1918 on the ground that he could not support the decision of the coalition Ministry to treat Welsh disestablishment as a *fait accompli*. Though no longer a minister of the crown, he nevertheless went over to Paris in 1919, where he served as chairman of the Supreme Economic Council, and played one of the principal parts, together with President Wilson and Gen. Smuts, in drafting the Covenant. After the peace he advocated increasingly full co-operation in the work of the League of Nations. In 1920 he attended the first Assembly of the League in Geneva as a representative of South Africa. In Parliament he steadily drifted into opposition to the coalition Ministry, and, though he did not form part of Bonar Law's Unionist Ministry in 1922, he joined Baldwin's first cabinet in May 1923 as Lord Privy Seal. He was raised to the peerage in Dec. 1923. He returned to office in Baldwin's second cabinet, in Nov. 1924, as chancellor of the duchy of Lancaster, and on several occasions acted as deputy for the foreign secretary, Sir Austen Chamberlain, on the Council of the League of Nations. As the principal British representative on the Disarmament Commission at Geneva in

1926–27 he found that his instructions necessitated a policy not in complete accordance with his convictions, and in 1927 he resigned his place in the Baldwin administration. President (1919–45) of the League of Nations Union, Lord Cecil remained, in face of the effects upon European and world affairs of German and Italian policy, uncompromisingly loyal to the League covenant. In 1937 he was awarded the Nobel peace prize.

**CECILIA, SAINT** (d. c. 176), patron saint of music and of the blind, is commemorated on Nov. 22. She was supposed to have been a noble Roman who with her husband and converts suffered martyrdom (c. 230), under the emperor Alexander Severus, but the researches of de Rossi (*Roma Sotteranea* ii. 147) confirm the statement of Fortunatus, bishop of Poitiers (d. 600), that she perished in Sicily under Marcus Aurelius (c. 176). The 4th century church at Rome in her honour was rebuilt by Pope Paschal I. (c. 820) and again in 1599. Cecilia, whose musical fame rests on a passing notice in her legend that she praised God by instrumental and vocal music, has inspired many a masterpiece in art, including the Raphael at Bologna, the Rubens in Berlin, the Domenichino in Paris, and in literature she is commemorated by Chaucer's "Seconde Nonnes Tale" and by Dryden's famous ode, set to music by Handel in 1736 and later by Sir Hubert Parry (1889).

Another St. Cecilia, who suffered in Africa in the persecution of Diocletian (303–304), is commemorated on Feb. 11.

U. Chevalier, *Répertoire des sources historiques* (1905), i. 826 f.

**CECROPIA**, in botany, a genus of trees (family Moraceae), native of tropical America. They are of rapid growth, affording a light wood used for making floats. *C. peltata* is the trumpet tree, so-called from the use of its hollow stems by the Uaupé Indians as a musical instrument. It is a tree reaching about 50 ft. in height with a large spreading head, and deeply lobed leaves 12 in. or more in diameter. The hollows of the stems and branches are inhabited by ants, which it has been claimed in return for the shelter thus afforded, and food in the form of succulent growths on the base of the leaf-stalks, repel the attacks of leaf-cutting ants which would otherwise strip the tree of its leaves. This is an instance of "myrmecophily," i.e., a living together for mutual benefit of the ants and the plant.

**CECROPS**, traditionally the first king of Attica (Pausanias ix. 33). He was said to have divided the inhabitants into 12 communities, to have instituted the laws of marriage and property and a new form of worship. The introduction of bloodless sacrifice, the burial of the dead and the invention of writing were also attributed to him. He is said to have acted as umpire during the dispute of Poseidon and Athena for the possession of Attica. As one of the *autochthones* (q.v.) of Attica, Cecrops is represented as human in the upper part of his body, while the lower part is shaped like a dragon. Miss J. E. Harrison (in *Classical Review*, Jan. 1895) endeavours to show that Cecrops is the husband of Athena, identical with the snake-like Zeus Soter or Sosipolis, and the father of Erichthonius-Erichthonius.

**CEDAR**, a name applied to several coniferous trees (see Gymnosperms), and a few broad-leaved species.

*Cedrus libani*, the far-famed Cedar of Lebanon, is a tree which because of its beauty and stateliness has always been a favourite with poets and painters. It is frequently mentioned in the Scriptures as a symbol of power, prosperity and longevity. It grows to a height of from 50 to 80 ft. and at an elevation of about 6,000 ft. above sea-level. The bole of young trees is straight and upright and one or two leading branches usually rise above the rest. As the tree increases in size, however, the upper branches become mingled together to form a clump-headed crown. Numerous lateral ramifying branches spread, tier upon tier, in a horizontal direction from the main trunk and cover a compass of ground the diameter of which is often greater than the height of the tree. The branchlets of the cedar assume the same orientation as the branches, and the foliage is very dense. The tree is evergreen; new leaves are developed every spring, but their fall is gradual. In shape the leaves are straight, tapering, cylindrical and pointed, about 1 in. long, dark green and borne in spirally arranged tufts of about 30. The male and female flowers grow on

the same tree but on separate branches. The cones, borne on the upper side of the branches, are flattened at the ends and are 4 to 5 in. in length and 2 in. wide; they require two years to mature and while growing exude much resin. The scales are closely pressed to one another, reddish in colour, and at maturity fall away from the central axis. The seeds are provided with a long membranous wing. The root system is large and ramifying. This cedar, which flourishes best on sandy, loamy soils, appears in great numbers on Mt. Lebanon, chiefly on the western slopes, where it usually occurs in groves, some of which contain several thousand trees. There are also large forests on the higher slopes of the Taurus and Anti-Taurus mountains. The wood is fragrant, though not so strongly scented as that of the juniper or red cedar of America. It is generally reddish-brown, light and of a coarse grain and spongy texture, easy to work, but liable to shrink and warp.

Mountain-grown wood is harder, stronger, more durable and exhibits greater dimensional stability.

The Cedar of Lebanon is cultivated in Europe for ornament only. It thrives well in parks and gardens, but the young plants are unable to withstand great variations of temperature. The term *Eres* (cedar) of Scripture does not apply strictly to one kind of plant: the "cedars" for masts, mentioned in Ezek. xxvii. 5, must have been pine trees. Drawers of cedar or chips of the wood are now employed to protect furs and woollen stuffs from injury by moths. Cedar wood, however, is said to be injurious to natural history objects and to instruments placed in cabinets made of it, because the resinous matter in the wood acts as a corrosive.

The genus *Cedrus* contains two other closely allied species, namely, *C. deodara*, the deodar, or "god tree" of the Himalayas, and *C. atlantica*, the Atlas cedar of the Atlas range in north Africa.

The deodar forms forests on the mountains of Afghanistan, north Baluchistan and the northwest Himalayas at elevations of from 5,500 to 12,000 ft.; it may develop a clear bole of from 60 to 70 ft. under the crown. The wood is close-grained, long-fibred, scented and highly resinous and resists the action of water. The foliage is of a paler green, the leaves are slenderer and longer and the twigs are thinner than those of *C. libani*. The tree is employed for a variety of useful purposes, especially in building. It is cultivated in England and in California as an ornamental plant.

*C. atlantica* has shorter and denser leaves than *C. libani*; the leaves are glaucous, sometimes of a silvery whiteness, and the cones smaller than in the other two forms. Growth is somewhat more rapid than that of the ordinary cedar, but the tree produces a similar timber. It is found at altitudes of from 4,000 to 6,000 ft.

The name cedar is applied to species of several other genera of conifers, including *Juniperus*, *Thuja*, *Libocedrus*, *Chamaecyparis* and *Cupressus*. *Libocedrus decurrens*, of western North America, is known in the United States as incense cedar. *Chamaecyparis lawsoniana* is the Port Orford white cedar, a native of Oregon and California. The Bermuda cedar (*Juniperus bermudiana*) and the eastern red cedar (*J. virginiana*) are used in joinery and in the manufacture of pencils. Another species, the Atlantic white cedar (*Chamaecyparis thyoides*), is found in swamps along the southern coastal plains. The Spanish cedar is *Juniperus thurifera*, a native of the western Mediterranean region. Another species, *J. oxycedrus*, common in the Mediterranean region, forms a shrub or low tree with spreading branches and short, stiff, prickly leaves. A species of cypress, *Cupressus lusitanica*, naturalized in the neighbourhood of Cintra, is known as the Cedar of Goa. The genus *Widdringtonia* of tropical and South Africa is also known locally as cedar. The Japanese cedar (*Cryptomeria japonica*) is more closely related to the bald cypress. The family Meliaceae (which is entirely distinct from the conifers) includes, along with the mahoganies and other valuable timber trees, the Jamaica and the Australian red cedars, *Cedrela odorata* and *C. toona*, respectively.

(E. S. Hr.)

**CEDAR-BIRD** or **CEDAR WAXWING**: see WAXWING.

**CEDAR CITY**, a city of Iron county, Utah, in the southwestern part of the state, at an elevation of 5,340 ft.; on federal highway 91, and the terminus of a branch line of the Union Pacific railway, constructed in 1923. The population was 6,172 in 1950 by the federal census. It is the largest city within a radius of 200 mi.; is surrounded by vast expanses of grazing country and potential agricultural land, with some 50,000 ac. in irrigated farms, and by great deposits of iron, coal and gypsum; and is the gateway to the Zion National park, Bryce canyon, the north rim of the Grand canyon, Kaibab forest and Cedar Breaks. A Branch of the State agricultural college is situated here. In 1849 an exploring party sent out by Brigham Young discovered the beds of iron ore which gave the county its name. A volunteer company established a colony at Parowan, the county seat, in 1851. Cedar City was settled in 1851, and became the centre of the iron industry of that period, sending 12,500 lb. of pig-iron to Salt Lake City in the next eight years, besides manufacturing many articles of iron. With the development of rail transportation from the east the industry languished. In 1923 mining was begun on a large scale around Iron Springs, 10 m. W. of Cedar City, and the present production (by stripping methods) is about 250,000 tons a year, averaging 53% in iron content.

**CEDAR CREEK**, a small branch of the North Fork of the Shenandoah river, Virginia (U.S.A.). It is known in American history as the scene of a memorable battle, which took place on Oct. 19, 1864, between the Union army under Gen. Sheridan and the Confederates under Gen. Early. (See SHENANDOAH VALLEY CAMPAIGNS.)

**CEDAR FALLS**, a city of Black Hawk county, Iowa, U.S.A., on the Cedar river, 100 mi. W. of Dubuque. It is on federal highways 20 and 218, and is served by the Rock Island, the Illinois Central, the Chicago Great Western and the Waterloo, Cedar Falls and Northern railways. The population in 1950 (federal census) was 14,336. More than 50 creameries are within a radius of 30 mi. The city is adjacent to the Josh Higgins state parkway. It utilizes its water power for sundry manufactures. It is the seat of the State Teachers college (established in 1876 as a normal school), which has a resident enrolment of more than 2,000.

Settlement began there in 1847. The town was laid out in 1851, and chartered as a city in 1865.

**CEDAR RAPIDS**, a city of Linn county, Iowa, U.S.A., on the Cedar river, in the east-central part of the state. It is on federal highways 30, 218 and 151; and is served by the Chicago, Milwaukee, St. Paul and Pacific, the Chicago and North Western, the Rock Island, the Illinois Central, the Cedar Rapids and Iowa City, the Waterloo, Cedar Falls and Northern railways and United Air Lines. The population was 72,149 in 1950; 62,120 in 1940; 56,097 in 1930; 45,566 in 1920 and 25,656 in 1900 by the federal census. The rapids in the river supply abundant water power, and the city ranks second in the state as a manufacturing centre, with an aggregate factory output valued at \$200,000,000.

The leading products are cereals, corn products, meat packing, road building and mining machinery, farm hardware, ice cream machinery, radio transmitters, poultry and stock food, and milling. There is "Quaker Oats," the largest single unit cereal mill in the world. The city has an extensive jobbing business in all staple lines, and is the distributing centre for a rich agricultural district. Bank deposits in 1950 amounted to \$120,622,869.

The city has an air of substantial prosperity. Its principal streets are 80 to 100 ft. wide, well paved and shaded. The assessed valuation of property in 1950 was \$117,879,852. There are 23 fine parks, in one of which (Hawkeye Downs) an annual rodeo show is held.

One Bohemian periodical and one Swedish, with a substantial circulation, are published there. Coe college, a co-educational Presbyterian institution, which grew out of the Cedar Rapids Collegiate institute (1851), was chartered under its present name and opened in 1881. It has an enrolment of 800.

Cedar Rapids was settled in 1838; incorporated in 1856; and adopted a commission form of government in 1908.

**CEDARTOWN**, a city of Georgia, U.S., 62 mi. W.N.W. of Atlanta, served by the Central of Georgia and the Seaboard Air Line railways; the county seat of Polk county. Pop. (1950) 9,469. There are important mineral deposits in the vicinity, especially of iron, manganese, marble and slate, and the town has diesel railroad shops, cotton and woolen mills, a tire cord fabric factory, etc. The Big spring, on the ancient meeting ground of former Cherokee Indian inhabitants, flows at a rate of more than 5,000,000 gal. of pure water daily, and gives the city its entire supply of water. It was incorporated as a city in 1898.

**CÉDULA**, the Spanish form of the English word schedule, of which "cédula" is an obsolete variant; in modern financial usage it refers more specifically to certain securities issued by the South American Governments.

**CEPALÙ** (anc. *Cephaloedium*), a seaport and episcopal see of the province of Palermo, Sicily, 42 mi. E. of Palermo by rail. Pop. (1936) 9,654 (town), 10,730 (commune). The ancient town is named from the headland (Gr. *Κεφαλή*, head) upon which it stood (1,233 ft.); its fortifications extended to the shore, on the side where the modern town now is, in the form of two long walls protecting the port. There are remains of a wall of massive rectangular blocks of stone at the modern Porta Garibaldi on the south. It does not appear in history before 396 B.C., and seems to have owed its importance mainly to its naturally strong position. A small ancient building in good polygonal work (a style of construction very rare in Sicily), consists of a passage on each side of which a chamber opens. The doorways are of finely-cut stone, and of Greek type. On the summit of the promontory are extensive remains of a Saracenic castle. The new town was founded at the foot of the mountain, by the shore, by Roger II. in 1131, and the cathedral was begun in the same year. The exterior is well preserved, and is largely decorated with interlacing pointed arches; the windows also are pointed. On each side of the façade is a massive tower of four storeys. The round-headed Norman portal is worthy of note. The interior was restored in 1559, though the pointed arches of the nave, borne by ancient granite columns, are still visible; and the only mosaics preserved are those of the apse and the last bay of the choir: they are remarkably fine specimens of the art of the period (1148) and were carefully restored in 1859-62. Fine cloisters, coeval with the cathedral, adjoin it.

**CEHEGÍN**, a town of south-eastern Spain, in the province of Murcia, on the right bank of the river Arcos, a small tributary of the Segura. Pop. (1940) 7,724 (mun. 17,316). Cehegín is the market for local wine, olive oil and hemp, and for marble and a little iron from the neighbouring hills. Some of the older houses, the parish church and the convent of San Francisco, which contains still legible Roman inscriptions, are built of stone from the ruins of Begastri, a Roman colony which stood on an adjacent hill. The name Cehegín is sometimes associated with that of the Zenaga, Senhaja or Senajeh, a North African tribe which invaded Spain in the 11th century.

**CEILING**, the overhead surface or surfaces covering a room; the under side of a floor or a roof; often used as a surface built to hide the floor and roof construction; the term is also employed, technically, for any finished boarding or sheathing, and especially for a type of narrow, thin board, tongued and grooved, with a moulding on the edge. Ceilings, in the larger sense of the word, have been favourite places for decoration from the earliest times, by painting the flat surface, as in the case of Egyptian tombs; by emphasizing the structural members of roof or floor, as in the beamed ceilings of the period of Francis I. in France, or the ceilings of Italian mediaeval churches; e.g., S. Miniato at Florence; by treating it as a field for an over-all pattern of relief; e.g., the earlier rooms of Hampton Court palace near London.

Of Greek ceilings little is known, except for some of marble, over temple porticos, decorated with small, sunk panels or coffers, with moulded edges, and the field further decorated in polychrome. Roman ceilings were rich with relief and painting as is evidenced by the vault soffits of Pompeian baths. Italian Renaissance architects found in similar examples inspiration for much

of their most charming painted and relief decoration in stucco, and Robert Adam's 18th century designs for ceilings ornamented with ovals, fans, hanging garlands, delicate scrolls and little painted panels, have the same origin. The general Gothic tendency to use structural elements decoratively led to the rich development of the beamed ceiling, in which large cross girders support smaller floor beams at right angles to them, beams and girders being richly chamfered and moulded, and often painted in bright colours (the palazzo Davanzati in Florence contains numerous late 14th century examples).

In the Renaissance, ceiling design was developed to its highest pitch of originality and variety. Three types were elaborated. The first is the coffered ceiling, in the complex design of which the Italian Renaissance architects far outdid their Roman prototypes. Circular, square, octagonal and L-shaped coffers, with their edges richly carved and the field of each coffer decorated with a rosette, abound. Occasionally pendants are found at the intersections (the Hall of the Two Hundred, in the Palazzo Vecchio at Florence and various rooms of the ducal palace at Mantua are good examples). The second type consists of ceilings wholly or partly vaulted, often with arched intersections, with painted bands bringing out the architectural design and with pictures filling the remainder of the space, as in the loggia of the Farnesina villa in Rome, decorated by Raphael and Giulio Romano. In the baroque period, fantastic figures in heavy relief, scrolls, cartouches and garlands were also used to decorate ceilings of this type; e.g., the Pitti palace, Florence; many French ceilings of the Louis XIV. style are similar. In the third type, particularly characteristic of Venice (e.g., the Doge's palace), the ceiling became one large framed picture.

The early Renaissance saw in England another interesting development, that of plaster ceilings covered with an intricate pattern of intersecting curved lines, ornamented with foliage, grotesque animals and heraldic devices, and frequently accented by repeated large pendants; e.g., Bramall Hall; Hatfield House, London; Knowle; Sizergh. Later, the skilful English plaster workers were trained into a more classic vein, largely through the influence of Inigo Jones, who developed a type with large and deeply recessed panels, bold mouldings and bands of high relief foliage and fruit, which remained fashionable for about a century after 1650. In modern work the general tendency is toward simplified ceilings. Rich colour decoration is, however, sometimes found, especially in public buildings; e.g., Nebraska State capitol, U.S.A., designed by B. G. Goodhue, with ceilings by Hildreth Mérieu.

(T. F. H.)

**CEILLIER, REMY** (1688-1761), Benedictine monk of the Lorraine congregation of St. Vannes, was born at Bar-le-Duc on May 14, 1688. He was the compiler of a scholarly *Patrology, Histoire générale des auteurs sacrés et ecclésiastiques* (23 vols. Paris, 1729-63, improved edition, 14 vols. Paris, 1858). His *Apologie de la morale des pères de l'église* (Paris, 1718), also won some celebrity.

**CELAENAE**, an ancient city of Phrygia, situated on the great trade route to the East. It was the starting point of the march of Cyrus (401 B.C.) with the 10,000 against Artaxerxes. Its acropolis long held out against Alexander in 333 and surrendered to him at last by arrangement. Antigonos made it the capital of his kingdom; Antiochus of Syria, the son of Seleucus refounded it on a more open site as Apameia (q.v.). West of the acropolis were the palace of Xerxes and the Agora, in or near which is the cavern whence the Marsyas, one of the sources of the Maeander, issues.

See G. Weber, *Dincir-Celènes* (1892).

**CELANDINE** (*Chelidonium majus*), a common British plant, a member of the poppy family (Papaveraceae), an erect branched herb from 1 to 2 ft. high with a yellow juice, much-divided leaves and yellow flowers nearly an inch across, succeeded by a narrow, thin pod opening by a pair of fine valves, separating upwards. The plant grows in waste places and hedgerows, and is probably an escape from cultivation. It has become widely naturalized in eastern North America, in open grounds, roadsides and in woods from Maine to Ontario and Illinois south-

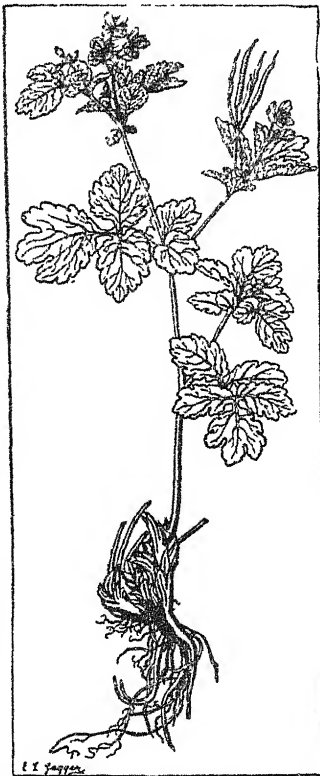


ward to North Carolina. The lesser celandine is a species of *Ranunculus* (*R. Ficaria*), a small low-growing herb with smooth heart-shaped leaves and bright yellow flowers about an inch across, borne each on a stout stalk springing from a leaf-axil. It flowers in early spring, in pastures and waste-places. It is sparingly introduced into the United States from Massachusetts to Maryland.

**CELANO**, a town of the Abruzzi, Italy, province of Aquila, 73m. E. of Rome by rail. Pop. (1936) 9,784 (town); 11,653 (commune). It is on a hill above the Lago Fucino, and is dominated by a square castle, with round towers at the angles, erected in its present form in 1451. It contains three churches with 13th century façades in the style of those of Aquila. The origin of the town goes back to Lombard times, but it was destroyed in 1223, and rebuilt on a different site in 1227. It was damaged by the earthquake of 1915. It was the birthplace of Thomas of Celano, author of the *Dies Irae*, and biographer of S. Francis and S. Clara.

**CELEBES**, one of the four great Sunda islands in the Netherlands Indies. It extends from 1° 45' N. to 5° 37' S. and from 118° 49' E. to 125° 5' E. From the backbone of the island, which runs north and south, three long peninsulas project north-east, east and south-east, respectively, the first being much the longest. These peninsulas form great gulfs—on the eastern side, from north to south they are: the Gulfs of Tomini, or Gorontalo, Tolo and Boni, the first being the largest. Thus the island is of very curious shape, and its length, 800m., and coast-line, 2,000m., are quite disproportionate to its breadth, which averages between 36 and 120m., and at one point narrows to eighteen. As a result, no place in Celebes is as far as 70 miles from the sea. Celebes is situated in a very deep sea, between Borneo, west, which is in a shallow sea, on a shelf off the continent of Asia, and New Guinea, east, also in a shallow sea, and on a shelf projecting from Australia. The coast is dangerously fringed by drying coral reefs with many shoals and banks. The whole island is mountainous. Two parallel ranges run from north to south in the main central mass, and a northern extension of this traverses the entire northern arm of Celebes to Manado. From these ranges a single range projects north-eastwards to the extreme end of the eastern arm of the island, and two parallel ranges run, in a south-easterly direction, throughout the greater part of the south-eastern arm. The great central ranges (with Mt. Koruwe, centre, and Mt. Bonthain, south, over 10,000ft.), throw out large spurs, which dominate the central and western parts of Celebes. In the extreme north-east (Mt. Klabat, 6,620ft.), and south, the mountains are volcanic, some in the former region being active, whilst solfataras and hot springs are found in Minahasa. Wide rift valleys between the mountain ranges contain several lakes—in the north (Minahasa), Tondano, 2,000ft. above sea level, 9m. long and 3½m. wide, (Gorontalo), Limboto, Batudaka, and Bolano Sawu, in the central nucleus. Lake Lindu, further south, in the same rift, Tempe and Sidenreng (monsoon lakes), and east of these, extending into the south-eastern arm, the principal lakes of the island—Poso, Matana and Towuti. They are very deep, Matana having been sounded to 1,500 am. Poso to 1,000 feet.

The rivers of Celebes are short and unimportant, for waterfalls



GREATER CELANDINE, A YELLOW FLOWERED PLANT OF TEMPERATE REGIONS. SOMETIMES USED IN MEDICINE

and rapids are frequent; their mouths are obstructed by bars, and there is very little coastal plain, save at the head of the Gulf of Boni and near Macassar and among mangrove-swamps of the north coast of the Gulf of Tomini. The Jenemeja, which flows into the Gulf of Boni, is wide and navigable for some distance from its mouth, the Poso, which enters the Gulf of Tomini, is also wide and navigable, for very small craft, to Paluasi, the Sadang, entering the Gulf of Mandar, on the south-west coast, has many affluents, and is navigable by sampans, the Lasolo, south-east, admits steamers for 16 miles from its mouth; the rivers of Gorontalo are very small. The best natural harbours are Manado bay, Amurang bay, Kwandang bay, and Dondo bay, on the north coast; Tambu bay, Pare Pare bay, and Palu bay (Donggala), on the west coast; Gorontalo and Poso, in the Gulf of Tomini, with the Gulf of Poh, which penetrates eastward for 22 miles; the bays of Tomori, Kendari, and Staring, in the Gulf of Tolo, and the bays of Mengkoka, Palopo, Usu (Luwu), and Sopang, in the Gulf of Boni. Off the west coast is the Spermdunde archipelago, a number of low islands surrounded by coral reefs; off the south coast, Saleyer (*q.v.*); at the end of the south-eastern peninsula are several islands, of which the most important are Kabaena, Muna, Wowoni, and Buton (*q.v.*). They are separated from the peninsula by the straits of Tioro and Wowoni, both dangerous. The Banggai or Peling islands lie off the eastern extremity of Celebes, and though they belong politically to Ternate, geographically they resemble Celebes. In the Gulf of Tomini are the Schildpad islands, extending for nearly 80 miles east and west, the chief of them Talata Koh, Togian and Batu Daka, the Sangihe (Sangir) islands (*q.v.*), form the north-east extension of Celebes towards Mindanao, in the Philippines, which is continued by the Talaua group, north-east of these. With the adjacent islands, the area of Celebes is estimated at 77,855 sq.mi. and without them—69,255 sq.mi. The population of Celebes and the islands under its government, included in the residency of Manado, was, in 1930, 4,231,900.

Its situation between the two shelves of the Asian and Australian continents makes the geology of Celebes specially interesting. The broad central block is a complex of igneous rocks, with granite, gneiss, diorite and amphibolite characters, pierced in places by later eruptives, mostly Tertiary. This block is enclosed around its base by Cretaceous rocks, overlaid by Tertiaries and recent alluvial deposits towards the coasts. In the south-east corner of the block there is a broad band of pre-Tertiary tuffs, fringed occasionally by coral limestone. The northern part of the Gulf of Boni is widely bordered by Pleistocene and alluvial deposits, resting in the north-east upon late Tertiaries: a band of old plutonic rocks stretches from near Paloppo across the Gulf of Boni and the south-east peninsula to the Gulf of Tolo.

The meridional ridge of Celebes has an axis of crystalline schist, tourmaline quartzite, and glaucophane schist, penetrated and overlaid by andesite and basalt, flanked by tuffs, overlaid by late Tertiary *Orbitoides* limestone. The southern extension from the central block shows late Tertiary limestone, raised in parts, to a height of more than 3,000ft. and portions of the Archaean foundation are revealed. East of the central block is a faulted and depressed area of crystalline schists and metamorphosed shales, with gneiss and metamorphic limestones. The south-eastern and eastern peninsulas are, in the main, a broken crustal block with plutonic rocks. Metamorphics run southwards along the Gulf of Poniland, a series of Pleistocene to recent rocks passes near to north of Muna island, with no Tertiaries except a small patch on Buton island. Around Mengkoka bay is a fringe of coral limestone, which borders Kabaena, covers more than two-thirds of Muna, all except the centre of Buton, and all of Wowoni, and the small islands north of it. There are indications of Jurassic rocks south of Lake Matana and metamorphics re-appear in Peling island. The north-eastern peninsula has northern and southern belts. The northern belt consists mostly of sedimentary rocks, Cretaceous or Tertiary, some altered by metamorphism. This belt runs parallel with the coast, and is separated by a parallel fault line from the southern belt, which consists of granites, gneisses, schists and intrusives, with Archaean schists and altered rocks, caught in faults: the valleys are filled with recent deposits.

Older rocks, Cretaceous and Tertiary, are preserved in occasional east and west bands, and in places near the south coast there are fringes of coral limestone. Minahasa is volcanic, and differs structurally from any other portion of Celebes.

The climate of Celebes is hot, but is tempered by sea winds, which reach every part. Mean temperature ranges between 86° and 72°, with absolute extremes of 94° and 66°: it falls to below 50° at high altitudes on the mountains. At Palu, on the west coast, rainfall averages only 20.92 in., as compared with 116.11 at Macassar, whilst Menado and Gorontalo, both in the north-eastern peninsula, average, the former 106.48 in., and the latter 47.45 only. Macassar averages 132 rainy days annually; Palu only 77.

In the matter of fauna Celebes is the poorest island in the archipelago in the number of its species, yet amongst these it has animal forms which have no close allies in any other part of the world, except in three of the neighbouring islands—Bachian, Buru and Sulu. Most interesting of these are the *babi-rusa*, or pig-deer, so named by the Malays from its long and slender legs, and curved tusks, resembling horns, the black, crested baboon (*Cynopithecus nigrescens*), akin to the African baboon, and the *anoa*, or dwarf-buffalo, hunted extensively by the natives for its flesh. There are peculiar varieties of other indigenous animals, including five squirrels, a pig, a deer, two wood-rats and two marsupials. Celebes has a number of peculiar species of parrots, woodpeckers, hawks, cuckoos, hornbills, starlings, flycatchers and pigeons; the Brush turkey is found there. Crocodiles are common, there are snakes of various kinds, and many peculiar species of beetles and butterflies, whilst there is a distinct cleavage between the freshwater fishes of Borneo and Celebes. Although it has species which belong neither to the one nor to the other, the fauna of Celebes is more Asiatic than Australian, and the island is established as a transitional region between the Oriental and Australian zoological regions: it is one of the oldest parts of the Archipelago.

Much of Celebes is still covered with forest, especially around the Gulf of Tolo, where it is almost primeval, and practically without tracks or clearings. The vegetation grows on the sides of precipitous and almost vertical mountain slopes, and the scenery is exceedingly varied and picturesque. "Nowhere in the archipelago," wrote A. R. Wallace, "have I seen such gorges, chasms and precipices as abound in the district of Maros; in many parts there are vertical or even over-hanging precipices five or six hundred feet high, yet completely clothed with a tapestry of vegetation." The rift valleys are extremely fertile, and there are extensive plateaux, at varying heights, where there is rich pasture land. The flora shows many resemblances to that of the Philippines, is more Indian in character in the west of the island, and more Australian in the east, and whilst the trees of the lower slopes of the mountains differ strongly from those of Java, and are smaller, the alpine flora is very similar. There are many kinds of palms—fan-leaf, rattan, sago, *Arenga saccharifera*, which gives fibre for ropes, juice for sugar, and a beverage known as "sageir;" bamboo, bread-fruit, tamarind and coco-nut trees flourish. Staple food crops grown are rice (mostly *sawah*) and maize; sugar-cane, tobacco and vegetables are also raised. The chief commodity for export is copra, followed by corn, coffee, nutmegs, rubber and kapok; copal, damar and rattan are collected, also cattle horns and hides, for export. Fishing for turtles and mother-of-pearl is carried on extensively, and there is a trade in ebony, sandalwood and timber of other kinds. *Kayulara* and *Kolaka*, two kinds of timber almost impervious to attacks of the pileworm, are found in Celebes, and there is teak on the island of Muna. Gold occurs in Menado, and there are three mines being worked there; nickel has been found and exploitation started in 1937; also iron, copper and lead, and in south Celebes, a little coal.

In Minahasa there are 105 people to the square mile, in other parts of Menado only 30, and in the rest of the island and dependencies, 37. The coasts are generally well populated: there are large stretches of mountainous territory entirely uninhabited. There are at least six quite different native peoples of Celebes—the Toala, Toraja, Buginese, Macassars, Minahasese and Gorontaloese. The first-named are found scattered all over the island, sometimes living in communities amongst other races, the result of

having been enslaved by them originally. It is thought that they represent the true aborigines of Celebes. They are short and dark and have wavy or curly hair, a broad, flat nose, prominent mouth, and receding chin. They are quite undeveloped and uncivilized, shy, jungle-dwellers, partly nomadic, but quiet good-tempered people, and with a distinct language of their own. The Toraja are a collection of tribes, living in central, south-east and east Celebes. Living in isolated groups, in a very thinly-populated country, they differ very much in development. Of Malayo-Polynesian stock, and divided into highland and lowland people, in some parts they have intermingled with the Toala; in others they have come under a Buginese and Macassarese civilizing influence. They are pagan (with an increasing Mohammedan element), are gradually giving up their fortified villages, in very inaccessible positions, for neat little settlements of houses standing each in its own garden, and they are becoming reconciled to the Dutch prohibition of head-hunting and of divination by spear-throwing, but they are unclean, short-lived, and weakly. The mountain peoples are more strongly built than those of the plains, with more prominent cheek-bones, thinner lips, and smaller eyes. Both have large mouths, thick lips, and, usually, a broad nose, skin varying from light to dark brown, and smooth, black hair, worn long. They are lazy, the women working harder than the men, but courteous and good-tempered, when their confidence has been gained. They are agriculturists, with only a few industries, such as plaiting, pottery, wood-carving and iron-working. Bark clothing is worn in remote districts, and Malayan style cotton garments where there is contact with superior races: many ornaments are worn, and teeth are filed. Society is organized on the family basis, and the tribe is an extension of the family, a man choosing a wife from another branch of his own family. There are no social distinctions, or tribal chiefs, and woman has, comparatively, a high position amongst the Toraja, being able to choose her own husband. They collect forest produce, and grow rice, possess their own language, with many dialects, and Christian schools are well received by them. The Buginese and Macassars are probably of Toraja descent, came into touch with Hindu culture in Southern Celebes, their home, and later were converted to Islam. They are now all Mohammedans, but with traces of Hinduism and paganism. Well built, fairly light-skinned, and energetic, they are very keen traders, of very moderate morality, proud, passionate and vindictive devoted to feasting, gambling and cock-fighting. As ship-builders and sea-farers, they are unsurpassed in the Archipelago; their excellent prahus are to be found everywhere in Malayan seas. Society is both endogamic and exogamic, with survivals of a matriarchate, but Mohammedan law and customs are displacing all others. Both peoples are abstemious, feed chiefly on rice, maize and fish, eating buffalo flesh on festive occasions only: clothing is Malayan in style. They are extremely industrious, but their industries are not in a high state of development. Weaving is one of the chief; cotton *sarongs*, of fine material, being exported in large numbers from Mandar. Plaited goods of superior quality are made in Boni, gold and silver-smiths are mostly in Macassar, Gowa, Mandar and Boni, ironworkers in Luwu, Laiwui and Mandar, whilst shipbuilders flourish in Pambauwang, the Bira regency, and elsewhere. Forest produce is collected, buffaloes, cattle and horses are kept, hunting and fishing are indulged in, for pleasure and as a means of livelihood, and their sea-carrying trade thrives in spite of steamship competition. A peculiar written alphabet, shared by Buginese and Macassars, is used also by some of the tribes of northern Celebes, and by people of Sumbawa. The Macassar language and Buginese, to which it is very nearly allied, belong to the Malayo-Javanese group. Arabic letters are now being used for religious literature, and books in Arabic are read. There is a slight native literature, historical, legal, epistolary, and poetical. The Buginese and Macassars, like other races in Celebes and throughout the Archipelago, are adopting Malay as a *lingua franca*, and are encouraged therein by Dutch authority. The Minahasese are quite distinct in type from the other inhabitants of Celebes, they are closely related to the people of the islands of Siau and Sangi, and are probably part of an immigrant race from the north which settled here, and in the Philippines, of partly Cau-

casian type. They have a very light skin (some of the women have red cheeks and lips), lighter than any other race in the Archipelago, high nose, prominent lips, eyes widely separated, stiff, short, black hair and pleasant features, and they are tall and strong. Like the Maoris, a few generations back they were a savage, warlike race, constantly engaged in raids and head-hunting. European influence has completely eliminated this, and today the Minahasese are Christian, live in European style (each village has its church and school), are cleanly, sober and industrious, make good soldiers, being used extensively in the Dutch Colonial army and police, and compete successfully with Ambonese and Eurasians as clerks, schoolmasters, etc. They have a native tongue, but Malay and Dutch are superseding it. Their territory proper is in the extreme north and northeast, cultivation (coffee, coco-nuts and spices are grown largely), is in the European style, and their numbers do not exceed 300,000. The Gorontalese, who live in the west and south of the northeastern peninsula, are of the Toraja family, not related to the Minahasese, and largely Mohammedan, a short, smooth-haired, and rather light-skinned people, with a marked difference between the people of the coast and inland. They are agriculturists (rice, maize, coco-nuts and tobacco are grown), forest products collected, and weaving and plaiting are carried on, some of the finest materials in Celebes being produced.

They are neither strong nor very industrious; preponderance of women has encouraged extensive polygamy. In numbers they are estimated at about 223,000. Pagan (inland) and Mohammedan coastal tribes live on Banggai and Peleng.

For administrative purposes Celebes is divided into two separate divisions—the residency of Celebes, with dependencies (southeastern, southern peninsulas and islands, and the west coast), and the residency of Menado (the northeastern peninsula and the coast of the Gulf of Tomini—including the Banggai Islands).

The population of Celebes and dependencies is 3,093,251, composed of 4,537 Europeans and Eurasians, 25,497 foreign Asiatics, including Chinese and Arabs, and 3,063,217 natives. The population is much larger on the coasts than inland. The chief port and trade centre and the seat of the resident is Macassar (*g.v.*), with a population of 84,855 (3,447 Europeans included). All the other towns of any importance of Celebes, quite small in comparison with Macassar, are on the coast; for communications hardly exist inland, although the whole country is under direct Dutch rule, with some modification in a few districts of Menado and in the two small states of Luwu and Wajo, where the "short declaration" applies. Authority is enforced by officials on tour and just suffices to pave the way for civilization. Bonthain, on the south coast, is a small port and trade centre (population 6,711); such, also, are Pare Pare, Mamudyu and Madylene on the west coast. On the Gulf of Boni are Kajang, Palima, Desu Bay, Palopo and Kolaka, and on the east coast and Gulf of Tolo—Kendari, Salabanka, Bunku, Koloneday and Luwuk, and on the southern shore of the Gulf of Tomini—Pagimana, Bunta, Posso and Parigi. Some of these places are very small, but all are ordinarily ports of call for ships of the Royal Packet Navigation company and trade centres, zones of collection for great tracts of the hinterland. The residency of Menado has a population of 1,138,655, including 3,146 Europeans and Eurasians, and 25,123 foreign Asiatics. The chief port and centre of administration is Menado, in the extreme northeast, on Menado bay, with a population of 27,544. Unlike the rest of Celebes, Menado has centres of population inland, on plateaus among the mountains, and of these Tondano (2,000 ft.), near the lake and river of the same name, is the chief, with a population of 15,007. It has a cool, refreshing climate, and, situated amid beautiful mountain scenery, is quite a health resort. A pretty little town near by is Tomohon, a few hundred feet higher, which has a training school for native girls and a training college for native preachers, and a wireless station. Gorontalo, on the south coast of the peninsula, is a very important port and trade centre. It has an excellent harbour, with a magnificent approach; mountain ridges, thickly clad with vegetation running down to the shore, on either

side of the narrow Gorontalo bay. (Lake Limboto is not far distant.) It has a population of 15,603, does a busy trade in copra, coffee and other products, and, like Menado, is in direct touch with ports in Java, Singapore and other large ports. Small ports on the north coast are Amurang, on the bay of that name, and with a safe anchorage in all weathers, Kwandang, on Kwandang bay, having ruins of an old fort, and Palehleh, a centre for the gold-mining district, near by; on the southeast coast are Kema, Buna and Jikol; on the west coast lies the port of Donggala (pop 3,821), the seat of an assistant resident. Service was suspended some years ago on a short tramway (28.7 mi. long), from Macassar to Takalar. Sea transport provides the principal, and in most parts, the only means of communication, though motor roads exist in Menado and southern Celebes. Macassar has cable communication with Java, Menado with Borneo, and Gorontalo with Ternate (Moluccas); there is a telegraph line between Amurang and Menado; and Macassar, Menado and Gorontalo have telephone systems. Imports and exports were respectively, in 1939, for Menado 3,280,000 and 5,176,000 guilders, and for Celebes and dependencies 16,028,000 and 17,057,000 guilders.

The Portuguese appear to have discovered and established some influence in Celebes in 1512 when they were monopolizing the spice trade of the Moluccas. The sultan of Macassar, as head of the state of Gowa (southwestern Celebes) favoured the Portuguese and the English, who later attempted to get a footing in Celebes. This annoyed the Dutch, who defeated the sultan early in the 17th century, though the Portuguese helped him. In 1607 a Dutch settlement at Macassar began to establish a firm trade footing in southern Celebes. The Dutch then used the sultan to check the power of Ternate in the Moluccas, and with their friendship he was able to subdue Boni, a rival state in southeast Celebes, and to hold Luwu, but he grew too powerful, and the Dutch (1654) conquered the island of Tidore in spite of a Macassarese fleet. War with Gowa, interrupted only by indecisive treaties, lasted till 1667, when the Dutch Admiral Speelman crushed Gowa and the Macassarese, with help from Boni, and imposed the Bongay treaty. Gowa abandoned all claims to supremacy, surrendered lands to the Dutch East India company, left to it trade monopoly, and fell into decay. Boni's growth in power led the Dutch later to protect the independence of Gowa but the Dutch used their Buginese allies of Boni in the early wars in Java, and during the British occupation of Java, Raffles had to send an expedition to Celebes against the unruly Buginese in Boni. When Dutch power in Java was restored, a Dutch expedition had to be sent to Boni; but it was not until 1848 that Boni submitted to the Bongay treaty in a revised form. The treaty was not kept and a second expedition, in 1859, made Boni a fief of the Netherlands government, while part of its territory was ceded to the Dutch. The last prince, La Pawowoni Kraeng Segeri, refused in 1905 to pay certain dues and interfered with other states, and he was banished, and Boni then lost its independence completely. About the same time Gowa interfered in another part of Celebes. The Dutch sent troops and in 1911, Gowa, too, was incorporated in Dutch territory. The state of Luwu signed the Bongay treaty in 1667, but it was not until after the Boni War, in 1861, that the Dutch succeeded in establishing any real influence there and there was some trouble in 1886 over the refusal of Luwu to pay a fine for the murder of some shipwrecked sailors on its coast; but in 1903 it agreed to abide by the "short declaration," which then was also applied to the state of Wajo, likewise a signatory of the Bongay treaty, but which had at times been in open revolt, often in trouble with Boni, and had experienced serious internal disorder as recently as 1902. Menado was first colonized by the Spaniards, on the northern coast, and settlers were attracted from neighbouring islands. The sultan of Ternate also claimed suzerainty over it, and fairly early in the 17th century the Dutch entered into relations with the natives of the country to protect them from both Spaniards and Ternate. In 1657 the present capital and fort were built, at Menado, and a trade agreement was signed for the delivery of a certain amount of ironwood annually. In 1677 the Sangi and Talau islands, and later, certain small kingdoms on the north coast, were placed under the rule of the Dutch governor of Ter-



nate, and from that time onwards Dutch influence expanded, until the conquest of the East Indies by the Japanese during World War II. Japan landed troops at the northern tip of the Celebes Jan. 11, 1942, and within a month controlled most of the island except the remote interior areas.

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**CELERY** (*Apium graveolens*), a biennial plant (fam. Umbelliferae) which, in its wild state, occurs in England by the sides of ditches and in marshy places, especially near the sea, producing a furrowed stalk and compound leaves with wedge-shaped leaflets, the whole plant having a coarse, rank taste and a peculiar smell. It is also widely distributed in the north temperate region of the old world. By improvement through breeding and selection and blanching, the stalks lose their acrid qualities and assume the mild sweetish aromatic taste peculiar to celery as a salad plant. A large number of varieties are cultivated by gardeners, which are ranged under three classes, green, white and red—the improved green varieties being generally the best flavoured and most crisp and tender. Red varieties are little known in the United States. Both blanched and green it is stewed and used in soups. In the south of Europe celery is much used in its natural condition. In the United States approximately 590,000 tons annually were grown commercially in 1940 and 1941. It was grown most extensively in California, Florida, Michigan and New York, in the order named, at that time.

*Celeriac*, or turnip-rooted celery (*Apium graveolens*, var. *rapaceum*), is a variety cultivated more for its roots than for the stalks, although both are edible. It is chiefly grown in northern Europe. (V. R. B.)

**CÉLESTE, MADAME** (1815–1882), French dancer and actress, was born in Paris on Aug. 16, 1815. As a little girl she was a pupil in the ballet class at the Opéra, and made her début at the Bowery theatre, New York city, at 15. In England in 1837 she gave up dancing, and appeared as an actress. In 1844 she joined Benjamin Webster in the management of the Adelphi, and afterwards took the sole management of the Lyceum till 1861. She retired in 1870. She died in Paris on Feb. 12, 1882.

**CELESTIAL MECHANICS** is the branch of astronomy that deals with the mathematical theory of the motions of celestial bodies. The foundation was laid by Sir Isaac Newton by the publication in 1687 of his *Philosophiæ Naturalis Principia Mathematica*, usually referred to as the *Principia*. Here he published the three laws of motion which express the principles of mechanics, consolidating progress begun with the pioneer work of Galileo Galilei earlier in the 17th century. Newton also formulated the universal law of gravitation which states that any two particles of mass in the universe attract each other with a force that varies directly as the product of the masses and inversely as the square of the distance between them. These foundations permit the statement of a problem in celestial mechanics in the form of a set of equations of motion, ordinary differential equations of the second order. A proper understanding of the subject requires knowledge of this branch of mathematics.

An important triumph of Newton's was that Kepler's three laws of planetary motion, which had been derived empirically by Johann Kepler, were obtained as a consequence of the law of gravitation in conjunction with the laws of motion, applied to the problem of two bodies (see ORBIT, in which basic technical terms used in this article are defined). The next in order of difficulty is the case in which three bodies are considered, the famous problem of three bodies. The solar system, consisting of the sun and nine known principal planets, all but three surrounded by one or more satellites, constitutes a problem of many bodies. The significant circumstance that the mass of the sun is about 1,000 times that of the most massive planet, Jupiter, makes the sun's gravitational attraction far outweigh the mutual attractions of the planets. This suggests a process of successive approximations that has become the standard procedure in the mathematical theory of planetary motion, the deviations from elliptic motion being called

the perturbations. In the case of the moon's motion the earth produces the principal attraction. Notwithstanding the very great mass of the sun, the effect of the sun's attraction is a small fraction of that of the earth owing to the close proximity of the latter. However, in the case of some satellites the perturbations produced by the sun's attraction may reach very sizable amounts. The mutual attractions of the component stars in triple and quadruple systems of stars suggest other interesting problems in celestial mechanics. In all known cases the configuration is always similar to that of the sun-earth-moon system, and methods similar to those employed in the study of satellite motion may be used. In part because of observational difficulties this field is not as far advanced as the study of motions in the solar system.

During the 18th century powerful analytical methods, made possible by the development of differential and integral calculus, were applied to the problems of celestial mechanics. These methods were generally successful in accounting for the observed motions of bodies in the solar system, and for more than 200 years this success built up a high degree of confidence in Newtonian mechanics and Newton's law of gravitation. This attitude was well expressed by J. H. Poincaré who wrote, in 1892, that "... the ultimate aim of celestial mechanics is to solve the great problem of knowing whether Newton's law alone explains all astronomical phenomena." On account of the necessary introduction of the theory of relativity the statement would require modification.

**Relativity Effects.**—It is now recognized that the Newtonian laws of motion and law of gravitation are approximations to the true laws governing the motions of celestial bodies (see RELATIVITY). It has been found, however, that the relativity effects, i.e., the deviations from the motions derived on the basis of the classical Newtonian theory, are exceedingly small in all astronomical problems. In the motion of the perihelion of the innermost planet, Mercury, and in a very few other cases, they are large enough to be revealed by the most precise observations. A comparison between observations and theory, in which the perturbations are properly taken into account, confirms the excess of the motion of the perihelion in the amount of 43 seconds of arc per century, as required by the theory of relativity. This is one of the most convincing observational proofs of the theory of relativity. The effect diminishes rapidly for planets at a greater distance from the sun. In the case of the earth the relativity advance of the perihelion is about 4 seconds of arc per century, just large enough to be confirmed by the observations. On account of the smallness of the relativity effects in problems in celestial mechanics the justified procedure is to continue the use of the equations of motion following from the classical theory, and to apply the small relativity corrections, if at all necessary, in a minor adjustment of the results.

**Gravitational Attraction of Finite Bodies.**—The Newtonian law of gravitation is stated for particles, not for bodies of finite extent. It was shown by Newton that bodies the masses of which are arranged with perfect spherical symmetry attract each other in accordance with the law of gravitation as if the masses were concentrated in the centres of the respective spheres. It is found that the effect of nonsphericity diminishes rapidly with the distance between the bodies. Hence in the solar system in which the principal bodies are all nearly spherical and the distances, as a rule, large compared with the dimensions of the bodies, it is in many cases permissible to treat the planets and satellites as point-masses. Some interesting exceptions exist: the innermost satellite of Jupiter's system revolves in an orbit the radius of which is only  $2\frac{1}{2}$  times the radius of the planet. Owing to its rapid rotation the planet is flattened, and its gravitational attraction differs appreciably from that of a spherical body of the same mass. The principal effect upon the motion of the satellite is an advance of the perijove and a backward motion of the node, both at the rate of  $2\frac{1}{2}$  revolutions a year. The innermost satellite of Saturn shows a similar effect with a rate of one revolution a year. These are extraordinary cases; in most satellite orbits the resulting effect is small.

**Other Branches of the Subject.**—A related branch of cele-

tial mechanics is the gravitational theory of rotating liquid or gaseous masses with applications to the earth and the other larger planets. Astrophysical applications to close double stars have become increasingly important (*see* GEODESY and PRECESSION OF THE EQUINOXES). Newton explained the ocean tides as caused by the gravitational attraction of the moon and the sun. Sir George Howard Darwin, in addition to developing modern methods of tidal analysis and tidal prediction, also treated the cosmogonic aspect of tidal theory in his work on the development of the earth-moon system (*see* TIDES).

The various subjects described are recognized branches of celestial mechanics, which may be understood to embrace all of gravitational astronomy. The central problem, however, remains that of the mutual attractions among three or more bodies, each treated as a point-mass. There are two distinct approaches to the subject. The astronomer is forced to use methods that lead to a practical solution, even if they have the defect that the representation of the motion is valid for a limited interval of time only. The mathematician insists on using only processes of unquestionable validity, and is not primarily concerned with the astronomical requirements. Both points of view are meritorious, and each has had effects upon the development of the other.

**Planetary Theory.**—An important method for the treatment of planetary perturbations was introduced by Joseph Louis Lagrange (1736–1813). In an elliptic orbit the six orbital elements have constant values, completely determined by the three co-ordinates and the three components of the velocity at any time. Since the attractions by other planets cause a planet to follow a path differing from a fixed ellipse, the elements of its orbit so determined will necessarily vary with the time. Hence one may describe the “perturbed” orbit of a planet by giving the elements as functions of the time. Lagrange’s method provides a process for deriving analytical expressions for the derivatives of the varying elements. These expressions are rigorous, but their integration requires the introduction of a process of successive approximations. The ordinary procedure gives rise to the presence of terms proportional to the time, in addition to periodic terms, in the final expressions for the elements. The terms proportional to the time,  $t$ , are called secular terms. Their presence raises such questions as whether the eccentricity of a planetary orbit may increase indefinitely, endangering the stability of the planetary system. Such a conclusion would be very superficial. The terms obtained in further approximations, having higher powers of  $t$  as factor, will modify the terms obtained in the earlier approximations in a manner that cannot be foreseen without appropriate mathematical analysis.

The integration of the periodic terms introduces divisors of the form  $kn+k'n'$ , in which  $n, n'$  are the mean motions of the two planets, and  $k, k'$  integers, both positive and negative. In the mean longitude the squares of these divisors occur. Whatever the mean motions, there will always be linear combinations  $kn+k'n'$ , small compared with either of the mean motions,  $n$  or  $n'$ . Such small divisors cause large coefficients in long-period terms, with the principal effect in the mean longitude. The motions of the planets Jupiter and Saturn furnish one of the most interesting illustrations of the effects of small divisors. The annual motions of the two planets are very nearly in ratio 5 to 2, which produces a long-period term with period of about 900 years. The amplitude of the perturbation in the mean longitude is 1,196 seconds of arc in Jupiter and 2,908 seconds of arc in Saturn. These are “the great inequalities” in the motions of these planets the cause of which was discovered by Laplace in 1786. The small divisors in celestial mechanics are related to the more general problem of resonance in mechanical systems.

A more direct approach to the solution of the perturbation problem is that in which the perturbations in the co-ordinates are obtained directly. Among the methods of this type that were employed with success may be mentioned those of Pierre Simon de Laplace and of Simon Newcomb. The apparent advantages are largely cancelled, however, in cases of planetary motion in which large perturbations due to small divisors are an important feature. In such cases a method in which the mean longitude is ob-

tained has decided advantages. By an ingenious procedure, P. A. Hansen succeeded in deriving a method that combines the advantages of the two solutions of the perturbation problem. This method has been tested in numerous applications, and was chosen by G. W. Hill for his theory of Jupiter and Saturn, the most difficult problem among the principal planets.

An accomplishment that demonstrated strikingly the power of the theory of planetary motions was the discovery of the planet Neptune in 1846. Its presence and location in the sky had been predicted with astonishing accuracy by J. C. Adams and by U. J. J. Leverrier from deviations in the motion of the planet Uranus (*see* NEPTUNE). Attempts were made to discover planets beyond Neptune by a similar procedure, but the discovery of Pluto at the Lowell observatory in 1930 must be ascribed to perseverance in systematic search rather than accuracy of prediction by mathematical theory.

**Secular Variations.**—Planetary theories of the types described are entirely satisfactory for the immediate purposes of astronomy; the construction of tables that represent the motion of a planet for a limited time, say, a few thousand years. For questions concerning the stability of the solar system or, generally, its configuration in the very distant past and future such representations of planetary motion are insufficient. The question arose whether the secular terms occurring in planetary theories could be avoided. Lagrange obtained a solution in which he ignored the periodic terms. Retaining only the terms of the lowest power in the elements he obtained for the variation of the elements two sets of linear differential equations with constant coefficients, the eccentricity and perihelion appearing in one set, the inclination and node in the other. For the principal planets of the solar system, excluding Pluto, these equations have been solved in closed trigonometric form. In a solution of this type one obtains for the eccentricity and perihelion of each planet expressions containing eight trigonometric terms, the separate terms constituting oscillations with periods ranging from 57,000 years to 2,100,000 years. Similar expressions are obtained for the elements defining the positions of the orbital planes in space. These results give at least some indication of the long-period fluctuations in the elements of the planetary orbits. They should, however, be applied with caution. Further approximations present the same difficulty of small divisors as is met in the case of the periodic perturbations of the ordinary planetary theory. A still outstanding problem is the inclusion of Pluto in the solution of the secular variations. This will require a novel approach since the ordinary procedure leads to divergent developments.

The asteroids or minor planets furnish a rich field of application of the processes of celestial mechanics. The existence of the gaps in the ring of asteroids leads to the difficult theory of resonance in planetary motion. The application of the theory of secular variations led K. Hirayama to the discovery of five families of minor planets. He concluded that the members of each family must be fragments of a larger parent body. F. L. Whipple established a similar relationship between the orbit of Encke’s comet and the orbits of certain meteors determined from trails on photographic plates obtained at the Harvard observatory (*see* MINOR PLANETS).

**Satellite Motion.**—A common feature of all satellite problems is that the motion proceeds at a much more rapid rate than among planetary orbits. In the moon’s motion the line of apsides goes through a revolution in about nine years, the node in 19 years. These periods should be compared with the periods of tens or hundreds of thousands of years that affect the motions of the perihelia and nodes of planetary orbits. Consequently, in a satellite theory one cannot permit the appearance of the time in the coefficients of perturbation terms in the manner in which they are tolerated in planetary theories. One must aim at expressions free from this defect. The most complete solution of a satellite problem is the lunar theory (*see* MOON). Elaborate investigations have also been devoted to the satellite systems of Jupiter and Saturn. These systems present cases of resonance that are among the more interesting problems of celestial mechanics.

**Modern Methods.**—From the time of Lagrange until the present mathematical astronomers have made attempts to introduce the more perfect methods used in the lunar theory into the problem of planetary motion. A method similar to that used by Charles Eugène Delaunay in the lunar theory has been applied to planetary problems, but its application to the entire system of principal planets would be exceedingly laborious.

G. W. Hill opened up a new approach to problems in celestial mechanics by his use of a periodic orbit as a first approximation to the lunar theory. This subject was very fully investigated by J. H. Poincaré, whose work has led to a clearer understanding of the mathematical questions involved. Principally because of his work it is now recognized that, from a mathematical point of view, even such perfect developments as the lunar theories by Delaunay and by Brown leave something to be desired.

On account of the analytical difficulty of many problems in celestial mechanics investigators have resorted to the method of numerical integration. The method is used extensively for calculating the motions of asteroids and comets, and also in mathematical researches in the problem of three bodies.

**The General Problem of Three Bodies.**—This problem possesses ten known integrals, all of an algebraic character. Such an integral is a function of the co-ordinates and momenta of the three bodies that remains constant throughout the motion. The original equations of the problem form a system of the 18th order, nine differential equations of the second order. With the aid of the ten integrals, the "elimination of the nodes" and the elimination of the time the system may be reduced to one of the sixth order. This reduction was actually made by Lagrange and improved by later authors by the use of the canonical form of the equations. The reduction of the problem of three bodies with the aid of known integrals suggested that, if additional integrals were discovered, the problem might be further reduced and even completely solved. All such attempts failed; finally H. Bruns, in 1887, proved that no further algebraic integrals of the three-body problem exist. Soon afterward Poincaré proved that no further integrals uniform with respect to the elliptic elements exist. This result is of the greatest importance since it proves that the developments in trigonometric series used in the astronomical methods cannot converge for all values of the constants within a finite range. It does not exclude such a representation in the case of particular orbits; obvious examples are furnished by the periodic solutions and by the particular solutions which were first studied by Lagrange (see TROJAN PLANETS).

The simplified problem in which one of the three bodies has negligible mass and moves in the orbital plane of the two massive bodies, which are supposed to move in circular orbits, is the so-called restricted problem. The system of equations is one of the fourth order with one known integral, the Jacobian integral. Let  $1-m$  and  $m$  be the masses of the finite bodies;  $r$ ,  $r_1$ ,  $r_2$ , the distances of the infinitesimal mass from the centre of the mass and the two bodies respectively, and  $V$  the velocity of the infinitesimal mass in a co-ordinate system the origin of which is at the centre of mass, and which rotates uniformly with the period of revolution of the finite masses. The Jacobian integral, if the units of time and distance are conveniently chosen, is then

$$r^2 + \frac{2(1-m)}{r_1} + \frac{2m}{r_2} = V^2 + C,$$

$C$  being an arbitrary constant. By putting  $V^2=0$  one obtains a single family of curves with  $C$  as parameter. These "curves of zero velocity" may be looked upon as barriers in the sense that an orbit for which the constant of the Jacobian integral equals  $C'$  can never cross any of these curves of zero velocity for which  $C'$  exceeds  $C$ . The curves of zero velocity were first introduced by Hill with application to the moon's motion and have figured prominently in more recent studies of the restricted problem.

A totally different approach to the solution of the problem of three bodies was made by using developments in powers of a variable related to the time. If applied to the original equations the method fails owing to the singularities of the differential equations that correspond to collisions. These singularities may be

removed by suitable changes of variables, a procedure known as regularization. The first significant step in this direction was made by P. Painlevé. In 1912 K. F. Sundmann obtained a solution for the general problem of three bodies that can be expanded as power series which are convergent, but not uniformly so, for all values of the time. This result is of great theoretical interest, although its actual application to astronomical problems is excluded by practical difficulties. Moreover, the form of the solution does not reveal the character of the orbits.

In the restricted problem, the use of the Jacobian integral permits the elimination of one of the velocity components. Hence the motion can be represented completely by a trajectory in a three-dimensional phase space comparable with a streamline in a noncompressible fluid. This approach permits an attack upon problems that were not accessible by other methods. The earlier developments are due to Poincaré; important advances were made by G. D. Birkhoff, especially on questions concerning the probability that a trajectory returns to the same small region in space.

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**CELESTIAL SPHERE**, the imaginary sphere of indefinite radius on which the positions of the fixed stars are defined by their directions relative to an observer at its centre. The earth's axis meets the celestial sphere in two points, the *celestial poles*. (See ASTRONOMY: *Spherical*.)

**CELESTINA, LA**, the popular alternative title attached from 1519 (or earlier) to the anonymous *Comedia de Calisto y Melibea*, a Spanish novel in dialogue which was celebrated throughout Europe during the 16th century. The authorship of the *Celestina* and the date of its composition are doubtful. An anonymous prefatory letter in the editions subsequent to 1501 attributes the book to Juan de Mena or Rodrigo Cota, but this ascription is universally rejected. The prevailing opinion is that the author of the 21 acts was Fernando de Rojas, apparently a Spanish Jew resident at the Puebla de Montalbán in the province of Toledo; R. Foulché-Delbosc, however, maintains that the original 16 acts are by an unknown writer who had no part in the five supplementary acts. Some scholars give 1483 as the date of composition; others hold that the book was written in 1497. These questions are still unsettled. The *Celestina* excels all earlier Spanish works in tragic force, in impressive conception, and in the realistic rendering of characters drawn from all classes of society. It passed through innumerable editions in Spain, and was the first Spanish book to find acceptance throughout western Europe. A Latin version by Caspar Barth was issued under the title of *Pornoboscoidascalus latinus* (1624) with all the critical apparatus of a recognized classic. James Mabbe's English rendering (1631) is one of the best translations ever published. The original edition of 1499 has been reprinted by R. Foulché-Delbosc in the *Bibliotheca Hispanica*, vol. xii (1902).

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**CELESTINE** (CAELESTINUS), the name of five popes.

**CELESTINE I**, pope from 422 to 432. After his triumph over the dissensions caused by the faction of Eulalius (see BONIFACE I) his episcopate was peaceful. He instructed Cyril, bishop of Alexandria, to inquire into the doctrines of Nestorius. To extir-



pate Pelagianism, he sent to Britain a deacon, Palladius, at whose instigation St. Germanus of Auxerre came to inculcate orthodoxy among the clergy of Britain. Celestine also commissioned Palladius to preach the gospel in Ireland which was beginning to rally to Christianity. Celestine was the first pope who is known to have taken a direct interest in Britain and Ireland.

See Duchesne, *Lib. Pontificalis*, t. 1.

**CELESTINE II**, pope in 1143–1144. Guido del Castello, born of noble Tuscan family, able and learned, studied under Abelard and became a cardinal priest. He was pope from Sept. 26, 1143 to March 8, 1144. He removed the interdict which Innocent II. had employed against Louis VII. of France.

See A. Certini, *Vita* (Foligno, 1716); Migne, *Patrol. Lat.* 179, 765–820; Jaffé, *Regesta Pontificum Romanorum* (1888), vol. ii., 1 ff.

**CELESTINE III**. (Giacinto Bobone), pope from 1191 to 1198, once cardinal deacon of Santa Maria in Cosmedin, became pope on March 30, 1191. Henry VI. of Germany forced the pontiff to crown him emperor, and three years later took possession of the Norman kingdom of Sicily; he refused tribute and the oath of allegiance, and even appointed bishops subject to his own jurisdiction; moreover, he gave his brother in fief the estates which had belonged to the countess Matilda of Tuscany. Celestine dared not excommunicate him. In England, Prince John and the barons refused to recognize the papal legate, the bishop of Ely. Richard I. had been set free before the dilatory pope put Leopold of Austria under the ban. He died on Jan. 8, 1198.

See "Epistolae Coelestini III. Papae," in M. Bouquet, *Recueil des historiens des Gaules*, t. 19 (1738 ff.); Migne, *Patrol. Lat.* 206, 867 ff.; further sources in *Neues Archiv für die ältere deutsche Geschichtskunde*, 2. 218; ii., 398 f.; 12. 411–414; Jaffé, *Regesta Pontificum Romanorum* (1888), vol. ii. 577 ff.

**CELESTINE IV**. (Godfrey Castiglione), pope in 1241, nephew of Urban III. (1185–87), was archpriest and chancellor at Milan, before he joined the Cistercians. In 1227 Gregory IX. created him cardinal priest, and in 1233 cardinal bishop of Sabina. Elected to succeed Gregory on Oct. 25, 1241, he died on Nov. 10 before consecration.

See A. Potthast, *Regesta Pontificum Romanorum*, vol. i. (1874), 940 f.

**CELESTINE V**. (St. Peter Celestine), pope in 1294, was born of poor parents at Isernia about 1215, and became a Benedictine. Living as a hermit he attracted other ascetics whom he organized into a congregation of the Benedictines which was later called the Celestines (*q.v.*). His *Opuscula* (Naples, 1640) are probably not genuine. A fight between the Colonna and the Orsini, as well as dissensions among the cardinals, prevented a papal election for over two years after the death of Nicholas IV. Finally, Celestine was elected on July 5, 1294. Apocalyptic notions then current doubtless aided his election, for Joachim of Floris and his school looked to monasticism to deliver the church and the world. Multitudes came to Celestine's coronation and he began his reign the idol of visionaries, of extremists and of the populace. But the pope was in the power of Charles II. of Naples, and became his tool against Aragon. When he wished to abdicate, Benedetto Gaetano, destined to succeed him as Boniface VIII., removed all scruples against this unheard of procedure by finding a precedent in the case of Clement I. Celestine abdicated on Dec. 13, 1294, and died in a monastic cell in the castle of Fumone on May 19, 1296. He was canonized by Clement V. in 1313.

See Herzog-Hauck, *Realencyklopädie*; Jean Aurélien, *La Vie admirable de . . . Saint Pierre Celestin* (Bar-le-Duc, 1873); H. Finke, *Aus den Tagen Bonifaz VIII.* (Münster, 1902).

**CELESTINE** or **CELESTITE**, a name applied to native strontium sulphate ( $\text{SrSO}_4$ ), having been suggested by the celestial blue colour which it occasionally presents. It is usually colourless, or has only a delicate shade of blue. It crystallizes in the orthorhombic system, being isomorphous with barytes (*q.v.*). The cleavage is a perfect parallel to the basal pinacoid, and a less marked parallel to the prism. Although celestine much resembles barytes in its physical properties, having for example the same hardness (3), it is less dense, its specific gravity being 3.9. It is less abundant than barytes, but is, however, much more soluble.

Celestine occurs in the Triassic rocks of Britain, especially in veins and geodes in the Keuper marl in the neighbourhood of Bristol. At Wickwar and Yate in Gloucestershire it is worked for industrial purposes. Colourless crystals of great beauty occur in association with calcite and native sulphur in the sulphur deposits of Sicily, as at Girgenti. Very large tabular crystals are found in limestone on Strontian island in Lake Erie; and a blue fibrous variety from near Frankstown, Blair county, Pa., is notable as having been the original celestine on which the species was founded by A. G. Werner in 1798.

Celestine is much used for the preparation of strontium hydrate, which is employed in refining beetroot sugar. (F. W. R.)

**CELESTINES**, a religious order founded about 1260 by Peter of Morrone, afterwards Pope Celestine V. (1294). It was an attempt to unite the eremitical and cenobitical modes of life. Peter's first disciples lived as hermits on Mount Majella in the Abruzzi. The Benedictine rule was taken as the basis of the life, but was supplemented by regulations notably increasing the austerities practised. The form of government was borrowed largely from those prevailing in the mendicant orders. Indeed, though the Celestines are reckoned as a branch of the Benedictines, there is little in common between them. During the founder's lifetime the order spread rapidly, and eventually there were about 150 monasteries in Italy, and others in France, Bohemia and the Netherlands. The French houses formed a separate congregation, the head-house being in Paris. The French Revolution and those of the 19th century destroyed their houses, and the Celestine order seems no longer to exist.

See Helyot, *Histoire des ordres religieux* (1792), vi. c. 23; Max Heimbucher, *Orden und Kongregationen* (1896), i. § 22, p. 134; the art. "Cölestiner" in Wetzer und Welte, *Kirchenlexicon* (ed. 2), Herzog-Hauck, *Realencyklopädie* (ed. 3) and *Catholic Encyclopedia*, vol. xvi. pp. 19, 20.

**CELIBACY**, the state of being unmarried. In the original Latin (*caelibatus*, from *caelebs*, unmarried) it meant merely the fact of being unmarried, but was later restricted almost entirely to the perpetual renunciation of marriage, especially for religious motives. Celibacy was a practice of various religions even in pre-Christian times, as exemplified in the Roman vestal virgins and in Buddhist monasticism. Judaism frowned on celibacy, and considered childlessness a reproach, for it banished the hope of begetting the Messiah. But marriage was rejected by the majority of the Jewish sect of Essenes, which arose about two centuries before Christ, probably from Persian-Babylonian influences during the captivity and from contact with Hellenism through the Greek language.

Christ commended celibacy for the sake of the kingdom of heaven (Matt. xix, 12), but did not prescribe it; and St. Paul praised virginity as better than marriage (I Cor. vii; 7, 32–40). Celibacy was a common practice among the early Christians, who were inspired by the example of Christ, the virtues of self-control and self-denial, and the freedom from family cares which would leave greater liberty for prayer, contemplation and apostolic activity, and would win the confidence and respect of the people. The practice was not confined to the clergy, but it became by church law an obligation for those who wished to embrace the clerical state.

**Origins of Clerical Celibacy.**—The majority of scholars agree that the law of clerical celibacy was not of apostolic origin. St. Paul recommended celibacy, but he also wrote that a bishop should be a man of one wife (I Tim. iii, 2; Titus i, 6). This was generally understood to exclude from bishoprics, not unmarried men, but rather men who had married more than once, at least after their baptism. A few contemporaries of St. John Chrysostom found in these texts a command that a bishop should have a wife, and this interpretation was revived in the 16th century by the Protestant reformers.

While no strict law of celibacy existed during the first three centuries of Christianity, its practice was in honour among the clergy from the time of the apostles. Tertullian admired the number of celibate clergy and Origen contrasted the spiritual fatherhood of the priests of the New Testament with the carnal paternity of the Levites of the Old Law. At the same time, ac-